CONSERVATION NOTES

EVOLVING A RATIONAL STRATEGY FOR AN INTEGRATED PROTECTED AREA SYSTEM IN MAHARASHTRA

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(With two text figures)

Introduction

An Integrated Protected Area System (IPAS) for biodiversity and natural resource conservation should form part of a rational land-use strategy for any region. This must take into account ecological aspects for the management of wilderness ecosystems, as well as the needs of local people who depend on natural resources for their subsistence. The relative importance of each Protected Area (PA) within the IPAS is related to their specific objectives. A Protected Area (a National Park or Wildlife Sanctuary) may support several important objectives or may have a limited role in the conservation strategy of the region. Primarily a PA is expected to preserve biodiversity and perpetuate the existence of all species within its communities. Those PA's that enhance these values are of greater importance than others that support objectives of secondary importance. A National Park with a large undisturbed core area would thus generally be of greater conservation significance than a small Wildlife Sanctuary with a limited goal such as supporting wildlife tourism or protecting a few large, conspicuous mammals.

The design and management of an IPAS requires :

a) Assessing the conservation status of its existing PAs.
b) Identifying specific objectives of each of the PAs.
c) Quantifying the level of sustainable resource-use by local inhabitants.
d) Providing rational criteria for the disbursement of funds, manpower and expertise based on the relative importance of each PA within the IPAS.
e) Using biogeographical criteria for selection of potential sites to be notified as additional PAs.

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To develop a conservation strategy for an area, there is a need to design a system with clearly defined objectives for each PA. Protected Area management must consider their size, shape, zonation and most importantly their relative conservation status within the IPAS. The management plans of each PA must provide a strategy to support the resource needs of local people living within and around the PA's. It is also essential to select the biologically most appropriate sites to notify new areas as PAs for inclusion in the IPAS.

Aims and objectives

This paper attempts to formulate guidelines for designing an IPAS for Maharashtra State, which has 29 Protected Areas. These have been established over the years without considering the conservation status of the area or assigning specific objectives for their management. No attempt has been made to develop them into a network of Protected Areas based on objective criteria. This paper thus focuses on establishing:

i) the biological values and the conservation potential of existing PAs ;
ii) the socio-economic milieu within these PAs, with a view to assess the levels of utilization of resources as against the conservation goals of the area ;
iii) Assessing the level of people-wildlife conflict.

This paper describes a rapid method to evaluate and compare the PAs and to assign a relative position for them in the present network. It takes into account their specific objectives as well as the present conservation status of each Protected Area. This would help to rationalize the distribution of funds and manpower for each PA in relation to its rating in the IPAS.

Part A of the paper thus states the possible range of objectives of each PA. It describes the number and size of existing PAs in different biogeographical areas of the State. It provides guidelines for rationalizing the allocation of land necessary to establish an IPAS that gives due weightage to the proportion of distinctive ecological systems in Maharashtra. The impact of resource use on PAs is analyzed and the pattern of conflict between conservation and utilization of resources in the PA is discussed.

Part B is aimed at ascribing 'notional values' for assessing the relative importance of each of the PAs within the IPAS. This gives due consideration to :

a) Bio- geographical and other biological values ;
b) The possibility of enhancing resource-use for local people through eco-development schemes; and,
c) An assessment of conflict between conservation and utilization.

These three parameters are graded for each PA to provide basic guidelines for their management. The management options that are suggested are related to the specific objectives of each of the PAs in the IPAS.

Method

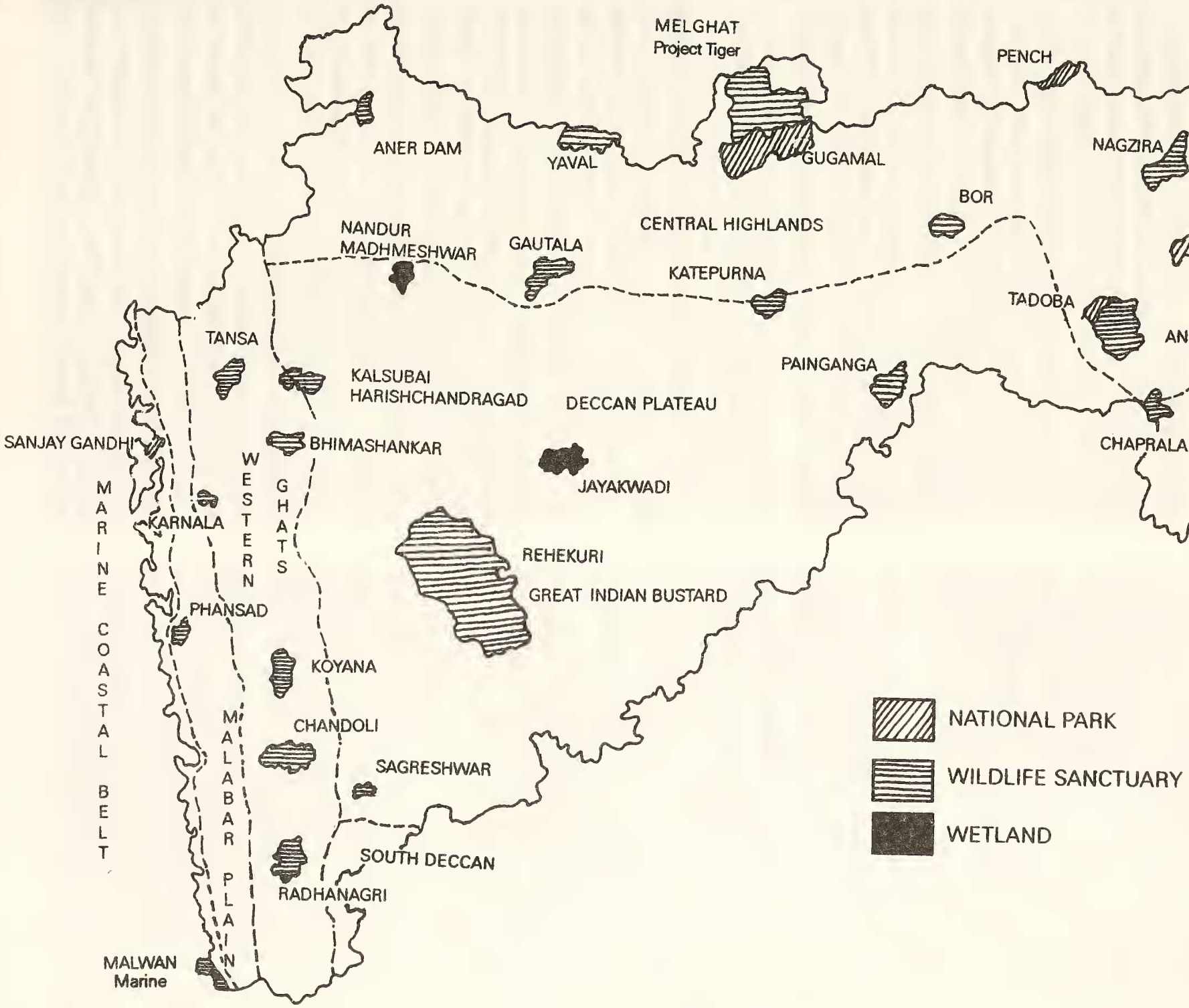
A review of the conservation status of the 29 PAs in the State of Maharashtra has been made. A random field study of sixteen of the Protected Areas was done to evaluate their present status and rank the relative importance of each PA. Data have been collected from the 29 Protected Area Managers through several questionnaires (See Annexure 1 and 2 for examples). The major and minor perceived objectives of each PA have been identified. The area included in the PAs have been related to the proportion of the different biogeographic landscapes and their ecosystems found in the state of Maharashtra. The size, shape, conservation status, and ecological categories of each PA and the presence of corridors have been evaluated. The pattern and intensity of local resource use, and the potential to reduce this pressure through ecodevelopment has been considered. Further the level and nature of conflict in each PA has been studied. These parameters have been used to grade PAs on a comparative scale using notional values for each parameter. The paper thus uses a method to gradually increase the sensitivity of notional values through gradual steps that take into account easily quantifiable parameters, which is then integrated into more complex concerns where quantification is less evident. Thus notional values of earlier tables in Part A have been used to improve the objectivity of the notional values used in Part B.

Discussion

Part A

Protected Areas are essentially established as a part of developing a rational land-use strategy to preserve biological diversity. To maximize this output for any area it is essential to devise an Integrated Protected Area System or a network of representative areas of different forms of wilderness found in a region.

Long-term planning for conservation requires a national or regional overview of residual wilderness, and remoteness and naturalness referred to as 'primitiveness' are the two environmental attributes that determine wilderness quality (Lesslie *et al.* 1988). The estimation of total wilderness quality by summing together four wilderness indicator values is used. They, however, stress that this rests on the assumption that the indicators themselves contribute equally to total wilderness quality, and that 'a unit of measurement or rating class for one indicator has equivalence with that for another. This paper also uses a similar system which has a greater degree of discrimination in placing values on different criteria. The specific conditions in India (and for this a case study for Maharashtra), which has great variations in biogeographic patterns, necessitates a finer grading for assessing the overall rating of PAs. This paper presents a more rational and sensitive method of evaluation. Lesslie *et al.* (op. cit.) also stress that there should be a weightage provided for 'perceived



PROTECTED AREAS OF MAHARASHTRA

importance'. A similar parameter has also been used in the present paper and is referred to as the 'potential value' of a PA. This, however, cannot be used in isolation as its actual value is a combination of its potential with issues such as effectiveness of management and the level of conflict due to resource use.

'Hot Spots' of biodiversity at global and national levels have been identified for inclusion into PA systems. An important feature even at regional level is to include locally identified 'hot spots' as PAs. Using Myers' (1988) classification of a 'Hot Spot' at the regional level, one should include those areas that are: '(a) Characterized by exceptional concentrations of species with high levels of endemism and (b) are experiencing unusually rapid rates of depletion.'

Myers' (op. cit.) statement that "This would help concentrate attention where needs are greatest and where the pay-off from safeguard measures would also be greatest" can thus be applied to provide a rule of thumb for identification and prioritization of conservation efforts in a group of PAs. Myers (op. cit.) stresses that the use of "working estimates" acts as a sound support to prioritize or select areas as "hot spots", in the absence of statistical information. Thus some data if gathered fairly objectively on a comparative scale is better than waiting till field studies and quantified estimates, that take a long time, are made. In critical situations this may amount to a delay by which time several species become extinct. According to Myers' (op. cit.) 'its cause tends to go by default.' He also claims that the "islanding effect" makes it possible for a park to safeguard only 50% of its original species complement, which must constitute 10% of the original expanse of habitat. It is also claimed that due to "ecological equilibration" there is a delayed fallout of species. This indicates that for most of our biogeographical landscape forms, the prospect of maintaining or holding the level of biodiversity in Maharashtra is poor. At the present rate of degradation biological values are bound to deteriorate, unless management is significantly improved.

As pointed out by McNeely (1994), for maintaining biodiversity there should be "a well managed system of PAs established in each country, including representative ecosystems and the widest possible range of a country's biodiversity." This is of equal importance at the regional level, i.e. in the individual states of India.

Wilderness can be classified in several ways, which facilitate the inclusion of representative landscape elements in the PA network. As stated by Presley and Logan (1994) " Land classes such as vegetation types, ecoregions, or environmental domains can be defined in many ways and at many scales." Providing a Classification is complex, as it is related to the multiplicity of elements present in a particular landscape pattern, especially as there is an added element in the mosaic produced by different levels of biotic pressure. It has been stated that " Reserve Coverage (the percentage of land classes represented in reserve systems) usually changed as the classes were defined more finely." Presley and Logan (1994) thus devised a system to ensure the inclusion of all important forms and their components. They have suggested a variety of *caveats* on the uses of land classes for judging reserve adequacy. This variable is expected to rely on more complex deliberations than measurement of coverage. They state that "...threshold areas for calling land classes 'reserved' are essentially arbitrary and indicate nothing about the viability of reserved populations (Leader-Williams *et al.* 1990), the status of source and sink areas (Pulliam 1988), landscape context and disturbance regimes (Moss 1987, Baurgeron 1988)..." Many regions have a mosaic of landscape forms with several sub-types. All land classes are said to be heterogeneous, both physically and biologically, they must also be accompanied by information on rare or patchily distributed taxa (Scott in Presley and Logan 1988). The different land classes are not equally important reservation sites as "those most at risk by extractive uses are most urgent candidates for the strictest protection." This is extremely relevant to our local conditions where most PAs support the biomass needs and fodder supplies of local people. They

conclude that "assessments of reserve coverage should therefore place much more emphasis on *which* land classes, rather than how many are to be preserved. Otherwise a high percentage of land classes represented could mark the frequent bias in reserve systems toward environments with low potential for major commercial use" (Presley and Logan 1988).

Several authors stress the importance of including rare species or relict ecosystems. The abundance and rarity factor depends on the size of a region under review. Hunter *et al.* (1994) have stated that "range size and local abundance are *not* independent. Local abundance is very variable. Therefore rarity must be examined in the context of the entire spatial distribution of abundance within the range carried away by local rarity." These authors also focus attention on the fact that it is incorrect to allocate relatively large sums to species that are only rare locally, while species threatened with global extinction receive far less funding (Hunter and Hutchinson 1994).

The other major aspect of developing an IPAS is the use of a graded evaluation scale for individual PAs which is based on a set of objective criteria. The conservation status of a PA is related to its relative importance within the group of PAs of an area. As the most important objective of conservation is the preservation of biodiversity it is essential to define the parameters that should be used for biodiversity assessment. The 'value' of biological diversity must include not only the variety of species found in an area but also the range of landscapes, natural communities, ecosystem types, the extent of endemism and the number of rare or threatened species.

In a situation in which there has already been an ad hoc selection of PAs, as in Maharashtra, identifying new PAs must be done with relevance to the existing network, to maximize biodiversity (Margules, Nicholls and Pressey 1988). They must include not only all possible species but all possible ecosystems or biogeographically unique areas. According to them this must include diversity, rarity, naturalness, size and representativeness. Including those areas that have rare species is of great concern. They also suggest that species poor systems are likely to have less unique species. It, however, also provides examples to demonstrate that size alone is not a satisfactory (or should not be the only) criteria by which PAs can be evaluated. The authors recognize that many of these discussions are based on pragmatic rather than on scientific grounds.

To allocate manpower and funds for management for PAs it is imperative to grade each PA on as objective a scale as possible. Wright (1977), reviewed several such scales. Workers such as Scott *et al.* (1987) argue that though PAs may have been initially selected to preserve large mammals or a few publicized bird species, they have inadvertently protected habitats and all their component species through better (although inadvertent) protection of the landscape.

Scott *et al.* (1987) state that the framework for the preservation of species ought to be fought at five levels in the landscape (Noss 1983): ecosystem, community, species, population and individual. Their paper stresses that "costly attempts at preserving much publicized individual endangered species may have a lower impact on the preservation of biological diversity than efforts to develop a rational management for groups of PAs within an area by managing ecosystems". Information on biological values of PAs coupled with data on trends in surrounding land-use patterns and management practices are all essential for developing a viable IPAS (Scott *et al.* 1987). These authors suggest that "there is less expense and more chance of success if extinction is fought by maintaining self-perpetuating populations of more common species. Species must be prevented from becoming endangered rather than to try to revert the process of endangerment." The present analyses suggest that prevention of ecosystem degradation is better than attempts at cure. It suggests that a multi-parameter assessment of individual PAs, and thus a successful management strategy of an IPAS alone will prevent extinctions in the long term.

Wilson (1992) eloquently expresses that if we went long enough to collect large quantums of

BOX 1

PROTECTED AREA OBJECTIVES

Each PA has several interlinked objectives which may be considered to be of primary, secondary or tertiary importance in achieving the goals of the IPAS.

(1) Preservation of the various biotic features of natural ecosystems, for protecting genetic resources and processes *in situ* and to preserve biodiversity at population, species, community and ecosystem levels. Special protection must be provided for known threatened or endangered plants and animals.	Primary
(2) Preservation of ecological processes of the natural ecosystem for:	
(a) Retaining soil	Secondary
(b) Stabilizing water regimes	Secondary
(c) Climate control at micro-level	Tertiary
(d) Contribute towards reduction of water and air pollution and global effects such as recycling of C_2 and CO_2.	Tertiary
(3) Conserving resources for local people and other groups:	
(a) Non-marketed - Consumptive and substinence resources such as food, fuel, fodder and non-wood products.	Secondary
(b) Marketed products - Small timber, non-wood products, honey, resins, roots, fish, etc.	Secondary
(c) Tourism - Recreational facilities.	Tertiary
(d) Opportunities for education and research	Tertiary
(4) Perpetuating 'existence' value: preservation of national and global heritage sites for the 'common good' of people for emotional, esthetic or ethical reasons.	Tertiary

Note: Without achieving the secondary goals, the PA's ability to reach its primary objectives is frequently doubtful. Their importance is thus not appreciably lower than those of the primary objectives. Tertiary objectives usually contribute in a limited way towards global environmental conditions or may benefit only a small specific section of society.

data it may be too late to preserve biodiversity, as there is only "one planet, one experiment". Thus rapid evaluation and immediate actions are of crucial importance.

The range of species, their population density, vegetation types, etc. forms the baseline data for selection of new sites, for modification of boundaries, for the application of management criteria, and to disburse funds for PAs. Those PAs that contain a larger proportion of rarer species or communities must undoubtedly be provided with a greater level of protection. There is little data to show the proportion of each vegetation type as classified by Champion and Seth within existing PAs of Maharashtra. Vertebrate species richness is said to be a good indicator of overall natural diversity. Vertebrate niches are shaped by a complex of biotic, abiotic, and cultural factors, such as the complexity of the community food web, total available biomass, and vegetation structure and productivity. There is evidence to show that there is a high correlation between vertebrate species-richness and overall natural diversity (Scott *et al.* 1987). This paper utilizes vegetation patterns as indicators of threatened systems and the known species richness of major vertebrates, as indicators of the value of each PA in Maharashtra.

Status of PAs in Maharashtra

For the locale specific issues related to Indian conditions, as for most other developing countries of the South, the conservation importance of a PA can be judged on three separate scales, each consisting of different parameters. These are :

(I) Based on their specific objectives;
(II) Based on landscape types; and
(III) Based on interactions between biotic pressures and management patterns.

I. PA OBJECTIVES

The 'perceived' objectives for establishing PAs such as the preservation of wildlife and nature, and to encourage wildlife tourism, are well known. However, a clearer perspective of the specific conservation objectives of each PA must be identified. Each PA has a group of more important, i.e. primary objectives and other objectives that can be considered of secondary or tertiary importance (See Box 1). A Protected Area's management should be aimed at achieving all its potential goals. Success in meeting perceived objectives, however, varies in relation to management and conflict levels.

PROTECTED AREA OBJECTIVES

The conservation objectives must include the protection of biodiversity, preservation of life support systems and the sustainable use of renewable resources within the regeneration capacity of its ecosystem. One of the objectives of Protected Areas is to develop a strategy to conserve the earth's "vitality and diversity" (Caring for the Earth. IUCN-UNEP-WWF-1991, p. 9). The buffer area of a PA should form a model for 'sustainable use' of resources, which can be replicated in areas outside PAs.

The PAs have global, national, regional (state) or sub-regional goals for conservation of biological diversity, and a variety of other natural resources and ecosystem services. The most important objective of PA management must be aimed at maintaining or enhancing its conservation prospects for preserving biological diversity. This is categorized as a primary objective. Preserving fragile ecosystems and / or preventing extinction of a specific species may constitute the other primary objectives of a PA.

Utilitarian objectives of National Parks or Wildlife Sanctuaries have a wide spectrum ranging from those that are beneficial to society at a global or national level, to the utilization of resources for restricted groups of society living within or adjacent to the PA. These are frequently secondary goals.

At a global level the forest PAs are said to contribute towards modifying climate, photosynthesis, or pollution. Another wide ranging benefit that has major implications for society at large, is to provide opportunities for research and education that broadens the scope of bio-sciences and gives new insights into the value of preserving Nature.

At a National level, PAs protect economically valuable 'gene pools' of animals and plants essential for genetic engineering. This is the potential raw material for the breeding of domestic animals and for the development of new cultivars. This financial implication for preserving biodiversity has now become one of the most important reasons for conserving genes, species and ecosystems *in situ*. Identifying new drugs and industrial products from the wilderness will indeed become a major national incentive to maintain PAs.

At the local level the PA's objectives may also be aimed at benefiting people living some distance away from it as well as those who live in and around it. The watershed protection afforded by a forest PA decreases peak runoff in the monsoon and prolongs the flow of water in summer. This supports urban and rural agricultural settlements downstream (Gadgil 1987). Wetland PAs act as flood buffers for surrounding areas. Grassland PAs can produce fodder for stall feeding domestic stock around the PA. The objectives of the PAs thus necessarily include supporting the needs of the local people. Its 'social' buffer should be capable of producing directly utilisable renewable resources such as fuel-wood, fodder, M.F.P. and marketable products on a sustainable basis. If this objective is not achieved, the PA cannot be expected to have a long term viability. Functions such as wildlife tourism serve the needs of a more limited segment of society, i.e.

those who visit it for recreational purposes (McNeely 1988, p. 21).

In Maharashtra, Forest PA's, such as Bhimashankar and Radhanagari in the Western Ghats are believed to harbour a high level of species diversity of plants and animals. The specific objectives of these important PAs thus place a great stress on maintenance of their gene pools (India: Conservation of Biodiversity WCMC).

An important objective of PAs such as Nagzira, Tadoba or Sanjay Gandhi National Park, that have large accessible populations of major mammals and forests which are visited by a large numbers of people, is wildlife/ecotourism. These PAs are thus potential sites for nature education through Interpretation Centers and Nature Trails.

The prevention of siltation of lakes due to erosion in the catchments of Koyna, Tansa, Sanjay Gandhi National Park, and Pench is an important objective of these PAs as this aspect has great economic implications.

A less frequently discussed objective of the wetland PA's of Nandur and Jayakwadi is their ability to be managed as "Multiple Use Areas". This function is linked to the survival of these PAs as carefully selected human activities do not negate their specific conservation objective of managing wetlands for conservation of waterfowl (Bharucha and Gogate 1990). This last group of spatially oriented objectives is related to the geographical and ecological conditions in which the PA is located.

The important criteria for rating PAs can thus be based on the relative importance of their perceived objectives. However, PAs may have different levels of success in meeting their objectives. Several management related issues must be taken into account to assess the potential of a PA in achieving its predetermined objective. PAs in which management is successful in meeting objectives would thus have to be given a higher rating in the IPAS. This must take into account not only the potential of a PA to act as a biological 'gene bank' at present, but its capacity through successful management to retain its wealth in the long term. This is related to the competence with which it is managed and the level of pressure on its resources. The species diversity found in some of these PAs should be carefully inventoried and quantified, as they are potentially valuable national and even globally important 'Hot Spots' of biological diversity. This is of great importance in the biologically rich PAs of the Western Ghats such as Bhimashankar, Koyna and Radhanagari.

II. LANDSCAPE TYPES

The PAs can be categorized into different landscape types, each of which have a set of specific characteristics. These are related to biogeographical features and differential levels of biotic influences. A landscape 'type' is also a reflection of the biotic province, the ecosystem, the size of the 'island' of wilderness notified in the PA, its shape and corridors connecting it to neighboring PAs.

BIOGEOGRAPHICAL FEATURES

a) Area included in the PAs of Maharashtra :

Table I shows that of the 3,07,690 sq. km of Maharashtra, 15,384 sq. km are at present within the PAs, i.e. 4.9% (Rodgers and Panwar 1988). However 8,496 sq. km of the area within PAs constitutes a single PA - the "Great Indian Bustard Sanctuary". This consists of predominantly agricultural land and includes the city of Solapur within its boundaries! As only about 400 sq. km of this PA is of significance for the protection of the Great Indian Bustard, the 8,096 sq. km of its agricultural area should not be considered to be of conservation significance for the PA network of the State. This leaves 7,288 sq. km within the viable existing network and constitutes only 2.3% of the landmass of Maharashtra.

b) Ecological categories:

An IPAS must reflect the proportion of distinctive biogeographic areas within the State. The

TABLE I
AREA WITHIN BIOTIC PROVINCES AND IN THE PA NETWORK

Biotic Province	Total landmass of Maharashtra (sq. km)	(A) % in each biotic province	Area under PA at present (sq. km)	(B) % of area in PA network	Area in PA if GIB reduced in size	(C) % of area in PA network reduced GIB
Western Ghats	3,000	10.00	1,993	12.90	1,993	27.30
N & N.E. Forests	40,000	12.90	4,086	26.50	4,086	56.06
Deccan Plateau	2,13,000	69,20	8,606	55.94	510	6.99
Konkan Plain and Coast	23,800	7.80	99	0.64	99	1.35
(Wetlands)	*3,000	—	600	3.90	600	8.23
TOTAL	3,07,800		15,384		7,288	
% of total land area			(4.9)		(2.3)	

* Not used in calculation as this is included in the terrestrial system
GIB - Great Indian Bustard Sanctuary; N & N.E. Forests - (Central Highlands) - North and North East Forests.

PAs can be divided into those that are established to protect terrestrial and aquatic systems. The terrestrial ecosystems constitute forests of different types (evergreen, moist deciduous, deciduous and thorn forests) as well as other ecosystems such as grasslands and scrubland in semi arid areas. The 3000 sq. km of wetlands in Maharashtra are associated with different terrestrial ecosystems in the State (Conservation of Wetlands in India - June 1989). In the PA network 600 sq. km of wetland is notified as PAs in the backwaters of two Irrigation Projects. The small but biologically valuable residual patches of mangrove found along the coast have not been included in the present PA network. (Conservation of Mangroves in India - August 1990). In most cases, they are not under the jurisdiction of the Forest Department and have even been classified as 'wasteland'! Only one marine system has been included in the PA network.

The PAs of Maharashtra have been grouped at a National level into three distinctive zones and four provinces (Rodgers and Panwar 1988). This includes : i) the deciduous hill forests of the North and North East region (which are called the Central Highlands of India); ii) the forests of the Western Ghats; iii) the grasslands of the semiarid Deccan; iv) the Konkan and coastal belt and v) the wetlands.

Table I shows the relative proportion of each region in the total landmass of Maharashtra - (A) (Rodgers and Panwar 1988). The area at present in the PA network in each biotic province and the percentage represented in the network - (B) and the percentage if the GIB sanctuary is reduced to 400 sq. km - (C) which is only 2.3%. Thus, within the network, a major proportion is represented in the Great Indian Bustard Sanctuary. However, if it were to be reduced in size, the residual PA network would be only 7,288 sq.km (Fig. 2.).

Though the percentage of area in the PA network - (B) appears to be representative of the State's biogeographic regions, it is effectively as shown in - (C), i.e. with a reduced GIB, which represents the viable area in the conservation network. The gross disparity in the proportion of land between the area in each Biotic Province as seen in - (A) & (C), i.e. if the GIB were to be reduced in size, is evident. The 69.2% of land in the State which is in the grasslands of the Deccan and that which is represented at present in the PAs is 55.9%. However, if the agricultural land in the

GIB sanctuary is excluded the total percentage of grassland within the IPAS would be only 6.9% which is thus a gross under representation. Whereas the N and NE region constitutes 10% of the total landmass of Maharashtra, it is over represented at present, constituting 26.5% of the PA network and would cover as much as 56.06% of the IPAS if the GIB sanctuary is reduced to a manageable size. This would make this forest system highly over represented. The highly fragile and species rich Western Ghats has a small proportion - 10% in the landmass of the state. This has a special conservation significance as a 'Hot Spot' of biodiversity. At present, it has 12.9% in the PA network, which would be 27.3% if the GIB Sanctuary is reduced in size. However it may be essential to include larger areas of the Western Ghats to protect this ecosystem and establish corridors between these PAs as they are Ecologically Sensitive Areas. Reducing the GIB Sanctuary in size would decrease the percentage of land in the IPAS from 4.9% to a meager 2.3%. This would have to be increased by including newly identified biologically appropriate areas.

In Table II, Columns B minus A, and C minus A provide an index of the extent of spatial over/under representation in relation to the relative proportion of the biotic provinces in the State. C minus A shows the degree of imbalance in the representation with an over representation of PAs in the forests of the North and North East (C-A = 43.16) and an under representation in the semiarid Deccan plateau (C-A = -62.21). Here it may be stressed that the biogeographic classification of India suggested by Rodgers and Panwar (1988) places this semiarid biotic province in a specific category which is restricted to Maharashtra. It thus has a national significance. These semiarid tracts had a variety of wildlife such as the Blackbuck, Chinkara, Wolf, Great Indian Bustard, Raptors, etc. which are now disappearing. This ecosystem has been converted through irrigation into an extensive farmland mainly for sugarcane, and the residual

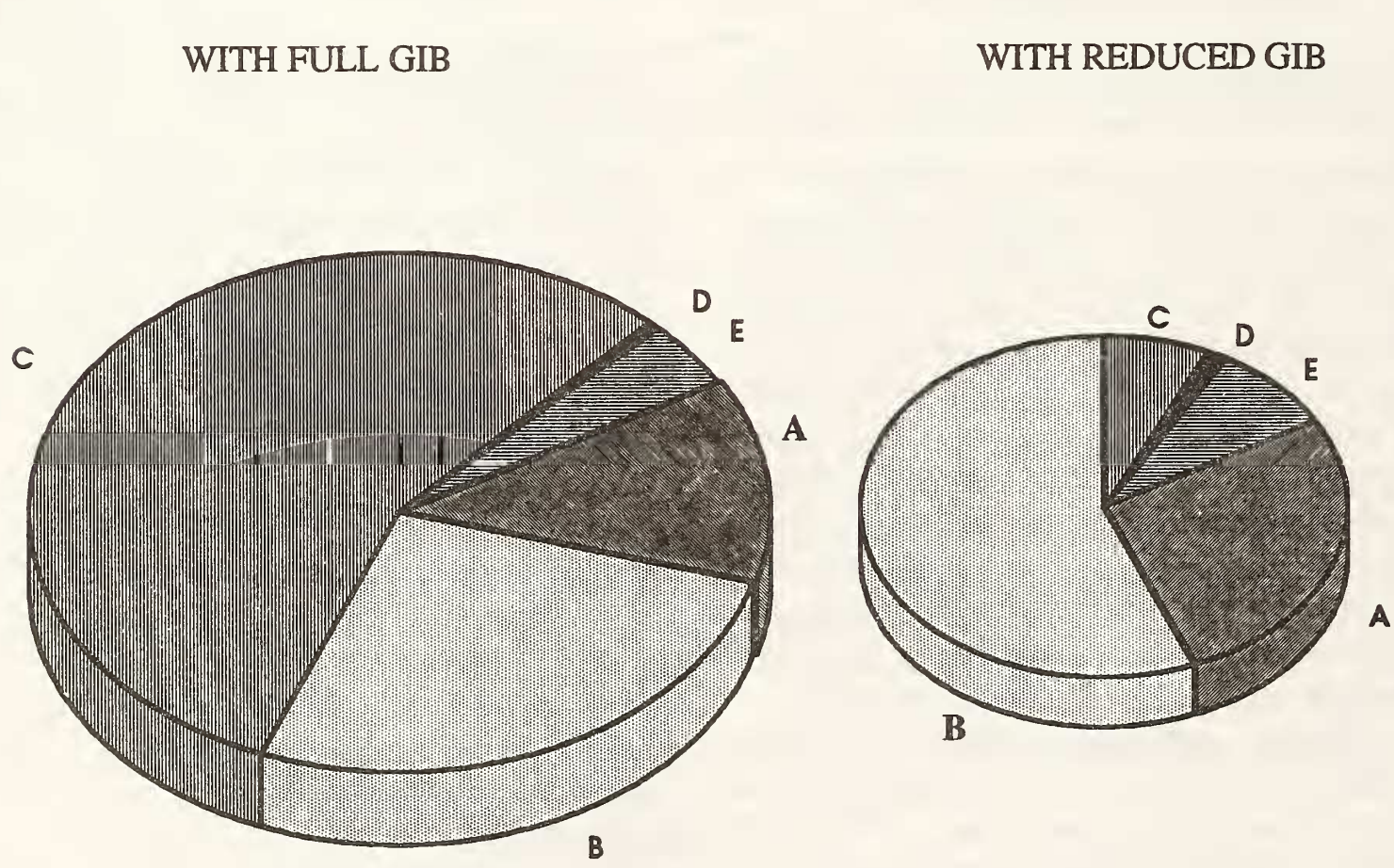


Fig. 2. Representation of Biotic Provinces in Maharashtra and in the PA network.
A - Western Ghats; B - North & NE Forests; C - Deccan Plateau; D - Konkan Plain & Coast; E - Wetlands.

TABLE II
PROPORTION OF BIOTIC PROVINCES IN THE STATE AND IN THE PA NETWORK

Biotic Province	% in biotic provinces in the state	% in PA network at present with full GIB	Over (+)/Under(-) representation on spatial basis	% in PA network if GIB is reduced	Over (+)/Under (-) representation on spatial basis	Notional value
	A	B	B-A	C	C-A	
Western Ghats	10.0	12.90	(+2.90)	27.30	(+17.30)	2
North & N.E. Forests	12.9	26.50	(+13.60)	56.06	(+43.16)	1
Deccan Plateau	69.2	55.94	(-13.26)	6.99	(-62.21)	3
Konkan Plain & Coast	7.8	0.64	(-7.16)	1.35	(-6.45)	3
Wetlands	—	3.90		8.23		2

*Based on size only. No values provided for conservation importance.

grasslands are over-grazed by the growing cattle population. This short grass system which in its undisturbed form, supported a large diversity of grasses and forbs is now being rapidly degraded. Those areas that still resemble the 'natural' grassland ecosystem require urgent protection by including them in the IPAS as new PAs. In evaluating the importance of a PA this can be used to provide a higher notional value for those systems that are under represented and have a 'minus' representation, and a lower notional value for 'plus' representations.

Though the amount of land in each biotic province constitutes a rationale for the percentage to be protected in each ecosystem within the IPAS, due importance must be given to a variety of other factors. An ecosystem approach is essential to provide a greater degree of protection for the preservation of distinctive landscapes or habitats and their component biotic communities (Table III, Fig. 2). A relatively larger representation in the IPAS must be provided for areas of national and international significance, i.e. for their uniqueness, or for those which are being rapidly degraded or converted to other uses. (IUCN: Conserving the World's Biological Diversity, 1990). In Maharashtra the fragile forest ecosystems of the Western Ghats fulfill these criteria (Rodgers and Panwar 1988, p. 199). To ensure their long-term viability, the PAs in the Western Ghats must be increased in size and be provided with a National Park status instead of being classified as Wildlife Sanctuaries. A change to National Park status for selected high value PAs would give them a higher level of protection. These should, wherever possible, be linked to each other through Reserved Forest or PA corridors. If these PAs are managed so as to constitute an interconnected chain, the needs of evolutionary processes are more likely to remain intact for a variety of endangered flora and fauna. Several Reserved Forest patches have been identified to provide such a continuous linkage. *Deorais* (Temple Groves) could form 'cluster' PAs of great conservation significance for endangered and endemic plants. These have patches of 'old growth' forest with high species richness. These have been maintained as intact plant communities which have been preserved due to local sentiments.

In the Konkan, the seashore, the mangroves, as well as the vegetation of the plain has been poorly represented (Rodgers and Panwar 1988, Vol.I, p. 204). New PAs for this region must be notified as early as possible as residual natural areas are being increasingly converted to other types of land use.

The various forest types and ecosystems in the PAs is given in Table III. This shows that there are only three PAs with evergreen vegetation, ten have semi-evergreen forests, fourteen have moist-

Table III
PAs IN MAHARASHTRA - TYPES OF ECOSYSTEMS

S.No.	Name	Status	Size	Biotic Province	Description	No. of PAs
1	Radhanagari	WLS	372	WG	Evergreen, semi evergreen, moist decid.	
2	Kalsubai	WLS	362	WG	Evergreen, semi evergreen, moist decid.	
3	Bhimashankar	WLS	131	WG	Evergreen, semi evergreen, moist decid.	3
4	Koyna	WLS	424	WG	Semi-evergreen, moist deciduous	
5	Chandoli	WLS	309	WG	Semi-evergreen, moist deciduous	
6	Tansa	WLS	305	WG	Semi-evergreen, moist deciduous	
7	Sanjay Gandhi	NP	86	WG	Semi-evergreen, moist deciduous	
8	Karnala	WLS	4	WG	Semi-evergreen, moist deciduous	
9	Phansad	WLS	70	C	Semi-evergreen, moist deciduous (and mangrove)	
10	Chaprala	WLS	135	N & NE	Semi-evergreen, moist deciduous	7
11	Melghat	WLS	1,597	N & NE	Moist deciduous, dry deciduous	
12	Gugamal	NP	362	N & NE	Moist deciduous, dry deciduous	
13	Pench	NP	257	N & NE	Moist deciduous, dry deciduous	
14	Nagzira	WLS	153	N & NE	Moist deciduous, dry deciduous	
15	Andhari	WSS	509	N & NE	Dry deciduous	
16	Painganga	WLS	325	N & NE	Dry deciduous	
17	Gautala	WLS	261	N & NE	Dry deciduous	
18	Yawal	WLS	178	N & NE	Dry deciduous	
19	Navegaon	NP	134	N & NE	Dry deciduous (and lake)	
20	Tadoba	NP	117	N & NE	Dry deciduous	
21	Bor	WLS	61	N & NE	Dry deciduous	11
22	Sagareshwar	WLS	11	DP	Southern thorn forest	1
23	GIB	WLS	8,496	DP	Grassland, scrubland	
24	Aner Dam	WLS	82	DP	Grassland, scrubland	
25	Katepurna	WLS	15	DP	Grassland, scrubland	
26	Rehakuri	WLS	2	DP	Grassland, scrubland	4
27	Jayakwadi	WLS	400	W	Wetland (and scrubland)	
28	Nandur-Mad.	WLS	100	W	Wetland (and moist decid.)	2
29	Malvan	WLS	29	M	Mangrove, coral reef & coastal scrub	1

WLS = Wildlife Sanctuary (24) NP = National Park (5)
WG = Western Ghats (8 PAs) N & NE = North & North East Forests (12 PAs)
DP = Deccan Plateau (4 PAs) W = Wetland (2 PAs) C = Coast (1 PA)
M = Marine (1 PA).

deciduous forests and eleven have deciduous forests. However, the area within most of the forest systems consists of large tracts of dry deciduous forests with a smaller representation of moist-deciduous vegetation and semi-evergreen components. The extent of evergreen patches is extremely limited and should be provided with an especially important status in the network.

The three PAs that have evergreen, semi-evergreen and moist deciduous forests include only 865 sq.km. Semi-evergreen and moist deciduous forests in 7 PAs cover 1333 sq. km. Moist and dry deciduous include 2369 sq. km. in 4 PAs. Purely dry deciduous forests cover 1585 sq. km in 7 PAs. One PA has thorn forest, 4 have grassland or scrub with 8595 sq. km, two are wetlands and one is marine. Table III.

c) Conservation Status :

Of the 29 PAs in Maharashtra, only one is fully notified. (Management of National Parks and Sanctuaries in India, 1989, p. 9). The absence of full notifications have serious implications in terms of management.

Out of the 29 PAs, only 5 (17%) have National Park status. The remaining 24 (83%) are Wildlife Sanctuaries and have a lower conservation status Table IV. Their status as NPs and WLSs, however, does not reflect their relative conservation importance among the Protected Areas. The functions of these NPs and WLS's do not conform with existing IUCN norms which would consider most of them as "Multiple Use Areas" (Ledec and Goodland 1988, p. 166-171). Settlements are found in 28 of the PAs and resources are used by the people both legally and illegally. This impact is unlikely to be reduced without a participatory approach to management where local people are involved and benefit from the PA.

In the past PAs were established on an ad hoc basis with a view to protect their major mammal species. The need to protect ecosystems, critically endangered habitats, visually insignificant species that are threatened by extinction, or areas of unique national or international significance, has only been appreciated in the recent past. Criteria for selection of new areas and for modification of the boundaries of existing PAs are essential to develop a long-term conservation strategy for Maharashtra.

(d) Size of PAs:

The potential to preserve a larger diversity of plant and animal species is generally greater in PAs of a large size. (Wilson 1992). As human population is expanding at a rapid rate, it is not feasible to allocate new areas for conservation. The size distribution of PAs in Maharashtra shows that 11 are between 250 and 1000 sq. km; 6 are between 100 and 250 sq. km while 10 are small, being below 100 sq. km in size (Table IV). Several of these PAs must be increased in size especially in the more fragile ecosystems which have a high species diversity to achieve important conservation goals. The relict forests of the crest line of the Western Ghats which are found in only a few residual patches must all be protected by large surrounding areas of forest on either side of the crest line. This would reduce the impact of surrounding human pressures on them.

The extremely large "paper" GIB sanctuary, however, could be effectively reduced to about 400 sq. km. Changes in the boundaries of some PAs are essential either to include adjacent forest or to exclude highly degraded areas of little conservation value. The size of a PA is closely related to its objectives. Protected Areas for conserving a rare plant could be perfectly adequate even if it covers only a few square kilometres. For conserving a species such as the tiger, a 250 sq. km sanctuary may be too small. Thus the intention to denotify a large part of Melghat, even though it includes several villages, is a highly damaging action for the conservation of the tiger and its shrinking habitat in the State. Providing notional values purely on the basis of size shows that thirteen PAs are over 250 sq.km in size and have a value of '3', six PAs are between 100 to 250 sq.km and are given a value of '2' ; while ten PAs are less than 100 sq.km and have

been given a value of '1' .

The debate on whether to have several small reserves or a few large ones is difficult to resolve and has been called the SLOSS problem (single large or several small). This needs to be appreciated on a case to case basis (Wilson 1992).

TABLE IV

SIZE DISTRIBUTION OF PAs IN MAHARASHTRA

Sr. No.	Name	Status	Size (sq. km)	Notional value
Category I A - 1000 sq. km and above				
1.	GIB	WLS	8,496	3
2.	Melghat	WLS	1,597	3
Category I B - 250 sq.km to 999 sq.km				
3.	Andhari	WLS	509	3
4.	Koyna	WLS	424	3
5.	Jayakwadi	WLS	400	3
6.	Radhanagari	WLS	372	3
7.	Kalsubai	WLS	362	3
8.	Gugamal	NP	362	3
9.	Painganga	WLS	325	3
10.	Chandoli	WLS	309	3
11.	Tansa	WLS	305	3
12.	Gautala	WLS	261	3
13.	Pench	NP	257	3
Category II - 100 sq.km to 249 sq.km.				
14.	Yawal	WLS	178	2
15.	Nagzira	WLS	153	2
16.	Chaprala	WLS	135	2
17.	Navegaon	NP	134	2
18.	Bhimashankar	WLS	131	2
19.	Tadoba	NP	117	2
Category IIIA - 25 sq.km. to 99 sq.km.				
20.	Nandur Mad.	WLS	100	1
21.	Sanjay Gandhi	NP	86	1
22.	Aner Dam	WLS	82	1
23.	Phansad	WLS	70	1
24.	Bor	WLS	61	1
25.	Malvan	WLS	29	1
Category IIIB - 1 sq.km. to 24 sq.km.				
26.	Katepurna	WLS	15	1
27.	Sagareshwar	WLS	11	1
28.	Karnala	WLS	4	1
29.	Rehakuri	WLS	2	1

N.B. WLS = Wildlife Sanctuary; NP = National Park.

(e) Shape of PAs :

Ideally, a PA should have as regular a perimeter as possible. In most of the PAs in Maharashtra the borders appear to have been delineated so that the PA can be easily administered. Frequently, little thought seems to be given to the inclusion of complete ecosystems or a complete mosaic of important components of the 'landscape type'. Inclusion of buffer areas for the PAs has also been neglected. There are PAs with several villages within them, while areas of vitally important neighbouring forest have been left out of the notification. A re-demarcation of the boundaries of some of the PAs is essential. A contentious issue is whether to include or exclude settlements lying geographically within a PA during notification. It is becoming increasingly apparent that re-location of these settlements is impossible due to paucity of land. Thus it may be administratively more appropriate to notify the area along with the villages and to ensure that eco-development becomes a part of the management of the PA. The ratio of the circumference to the size of the PA is an index of its regularity. The smaller the perimeter, the more compact and manageable the PA. Reliable data on the perimeter of each PA is not available.

(f) Corridors for PAs :

To improve the ability of PAs to support genetic and evolutionary processes, they should be linked to each other, if possible, through corridors. This is especially important in the species rich Western Ghats. Notifying existing Reserved Forest patches in this area as Wildlife Sanctuaries should be attempted between Bhimashankar and Koyna and could extend further south to link Chandoli and Radhanagari. The notification of the proposed Fr. Santapau Sanctuary would have great conservation importance for the state. Grassland fauna such as Blackbuck that now live in small hyper-dense, isolated populations would also benefit if corridors could be developed between PAs. However, in this ecotype corridoring is less feasible, due to extensive

agricultural tracts in the Deccan Plateau.

III. Biotic pressures and management patterns

Interactions between the biotic pressures and the past and present management practices of the PA produce a spectrum of changes on the naturally occurring landscape types. Thus 'natural' patterns may undergo varying degrees of degradation. Plantation especially of exotic species, undermines the 'naturalness' of the vegetation.

Protected Areas can have multiple uses. However this is frequently a carefully adjusted compromise. (Whitmore 1990).

The PAs and Resource Use

PAs have several tangible and intangible economic benefits. Some resources, such as, food, fuelwood and fodder, which are collected from the forest are easily quantifiable. This aspect has led to the establishment of what have come to be known as 'Extractive Reserves'. Other benefits, even if obvious, cannot be easily quantified in financial terms. For instance, the value ascribed to protecting soil and water is difficult to quantify. Forest PAs in hilly regions are more effective mechanisms for soil and water conservation than those in the plains.

In a forest system the most obviously quantifiable economic return is from timber; in a wetland, the economic potential of fish is most evident, while in a grassland, the biomass available as fodder form tangible economic indicators. However, since a PA is primarily intended to protect ' natural ecosystems', the uncontrolled use of these major resources would damage the conservation status of the PA. Such use may have to be restricted or in some cases prevented altogether. Resources must therefore be substituted through alternate means such as an ecodevelopment programme.

There is evidence to show that the timber value of a forest may in fact be less than the value obtained from Minor Forest Produce (MFP) that can be collected and sold on a sustainable basis. "Though this varies according to the site, it may well be as high as 75% if a detailed financial analysis is made". (Callish, Fight and Teeguarden 1978). The value of MFP is said to be 'higher than timber' and is more capable of being exploited sustainably (Peters, Gentry and Mendelson 1989). In many PAs, a sustainable amount of non wood products be collected without a major negative impact on its conservation values. This may add to the 'social value' of the PA which increases its local acceptability. Similarly, the value of harvestable resources such as fish from a wetland PA, which also gives protection to water fowl may be considerable (Bharucha and Gogate 1990). Fodder yields can be increased from grassland Protected Areas through good rangeland management. This could support both wildlife and a regulated number of livestock.

If natural resources such as fuel, fodder and MFP are used from PAs, it is important to quantify the extent to which this can be done without affecting its primary conservation objectives (Annexure II). Since the carrying capacity of the PA must consider the population of wild herbivores as well as a permissible number of cattle, it is essential to estimate their total fodder requirement. In most of our PAs the cattle outnumber wild herbivores.

If fuelwood and fodder collection is found to degrade a forest PA, it must be substituted from alternate sources. This is one of the major objectives of "ecodevelopment" for PA settlements. Buffer management must provide for these resources. A Participatory Rural Appraisal forms an objective basis to decide on how much land must be made available to develop such resources.

A tangible and easily quantifiable economic potential of PAs is through sustainable levels of wildlife tourism. Several authors have assessed the positive and negative impacts on conservation due to wildlife and ecotourism. (Phillips, Ademowicz and Boxall). The problem is that these financial benefits do not reach the 'local' people, who are adversely affected by the rise in prices of essential commodities around the PA. The revenue

earned from tourism in the PA is not transferred to the PA for its better manage-ment for a variety of administrative reasons.

It is important to assess if tourism is causing a detrimental effect on the less robust habitats or threatened wild species. It is also essential to predict if it is likely to affect conservation values in future. Some PAs have very little tourism, due to the low accessibility of major glamour species, inadequate facilities, or a lack of available information about the PA. The ability of controlled tourism to enhance nature awareness among the public is a benefit to conservation itself. PAs can be considered an educational asset if an Interpretation Centre is developed. Managers of the PAs have stated that the number of visitors in different PAs is highly variable, most being day visitors. Koyna, Chandoli, and GIB had up to 5 thousand visitors per year, Andhari and Rehakuri between 5-10000 per year; Melghat and Radhanagari between 10-20 per year; S. Gandhi, Andhari, Pench, Yawal, Nagzira, Navegaon, Tadoba and Sagareshwar had over 20000 tourists per year. Most of the tourists are only casually interested in wildlife or use the PA as a holiday resort. Most PAs do not have an Interpretation Centre to orient them towards eco-tourism. Some tourists are attracted by the scenery, climate, or a venerated shrine.

IV. Conflict

The interaction between conservation goals and resource use leads to the "not in my backyard" phenomenon. This is the most contentious issue that confronts several PA managers. Compensation for loss of life or property damaged by wildlife is a major problem. An indication of the level of conflict in the form of cattle lifting by predators showed that Melghat had to pay a very high rate of compensation. Kalsubai, Chandoli and Bhima-shankar also reported a large number of cattle kills. Attacks on humans were recorded from S. Gandhi and Nagzira. Serious crop damage was reported from Navegaon, Bhimashankar, GIB and Rehakuri; and moderate damage from Koyna, Radhanagari and Katepurna.

Crop damage due to Wildboar, Nilgai or Sambhar was reported from nearly every forest PA. Blackbuck was mainly responsible for crop damage in the GIB, Rehakuri and Katepurna Sanctuaries.

Impression

A scale to rate each of these PAs on the basis of its objectives and the three key parameters could help managers decide on conservation priorities for Maharashtra. This could also be used to modify and provide a pattern of management for the different PAs in the IPAS.

Part B

An Evaluation Scale for Grading Protected Areas

Among the most complex issues that must be considered while developing management plans for PAs are the difficulties in evaluating individual PAs and giving them relative ratings within the IPAS. This is however essential to allocate funds and manpower in a logical proportion for each PA.

The 'value' of biological diversity of an area must be assessed on parameters such as the level of biodiversity and its relative 'uniqueness'. At the species level, this includes the number of plant and animal species, the extent of endemism and the number of rare and threatened species. It must also take into account the systems level, i.e. the type and variety of landscapes, which represent various ecosystem types and the variety of plant and animal communities present in an intact form. Each landscape form is overlaid by the level of pressure on the 'natural' system due to which they display variable degradation forms. This results in a loss of their component species and an invasion of those that are colonizers in secondary vegetation. This is also related to the level of management which attempts to reverse or arrest deterioration. In some

situations management may be incapable of mitigating existing levels of conflict between the people's needs and the conservation of biodiversity, resulting in a gradual degradation into less valuable biological communities. The number of species within an ecosystem can, however, be used as a fair indicator of the value of an area for prioritization in the IPAS, if ecosystem specificity is also given adequate weightage.

Though a variety of grading methods have been evolved by several authors, especially for Australia, USA and South America, they are not directly applicable to the scenario found in India. This paper presents a rating for the PAs of Maharashtra on a uniform evaluation scale based on a standardized scoring system. The system considers.

I) The objectives,
II) The key parameters, and
III) The potential values of PAs which include:
   A) The conservation potential;
   B) The utilitarian potential, and
   C) The conflict level resulting from interactions between protection and resource-use.

A similar grouping has been attempted by Wright (1977), on reviewing several grading schemes. It is suggested that there should be four groups of parameters that must be considered:

Group I : Scientific criteria (Biological and Physical characteristics);

Group II : Use values;

Group III : Degree of threat;

Group IV : Availability.

The above grouping has certain parallels with the grading scale evolved for Maharashtra.

Several authors caution that providing numerical scores should not disguise the use of subjective value judgments that were used for scoring. This is indeed a relevant argument. It is essential to describe clearly the subjective criteria on which the notional values have been ascribed. This paper provides a carefully specified set of criteria, as a safety measure against such a situation. Wright (1977) stresses the importance of including an appraisal of management in judging the conservation potential of an area. The data for their paper has been made on standardized cards similar to the questionnaires used to collect data in this paper.

Dony and Denholm (1985), stress the importance of a 'rarity' score. They state that the most popular criteria are diversity (richness), size, rarity, threat of human disturbance and naturalness, the first three being quantifiable. Their paper also differentiates species richness and diversity. The diversity values can be affected by variations in area, homogeneity or maturity. They claim that rare species are generally most vulnerable to human pressure and indicate unusual ecological conditions. In several 'tropical' and monsoonal forest systems the number of trees that account for 50% of the sample invariably include less than 10% of the species. Field studies in the Western Ghats being carried out by the present author shows that it is the rare species of trees that are progressively lost as intact forest systems are converted to degraded forests and finally into scrubland. However, all the sites which need to be protected may not have rare species and still need to be preserved in an IPAS Dony and Denholm (1985) also mention the problem of scale, i.e. rarity must be assessed at local, regional or national levels to be meaningfully used to develop management strategies.

The vegetation patterns of PAs can be classified into different ecosystems and different forest types Puri *et al.* 1983). The conservation status of a PA is a reflection of the various grades of biotic pressure of a variety of types that affect the ecosystem. Important parameters for judging its status are its biological values, such as the 'naturalness' of the vegetation and the presence or absence of 'glamour' wildlife species for tourism. Using these parameters, the conservation potential can be divided into four grades.

PAs must also support local people with resource-needs such as timber, fuel-wood, and fodder as well as support adequate tourist facilities. This aspect has been allotted four grades.

A third aspect is the grading of the level of 'conflict' between the needs of people and

conservation goals, due to the proximity of the PA and its wildlife to human habitation.

These multiple factors and their interactions produce a variety of situations that affect the conservation of biodiversity in each of the PAs that constitute the IPAS (Ledec and Goodland 1988, McNeely 1988, Peters *et al,* 1989, Phillips *et al.*).

This grading scale has been established on the basis of 'notional values' that ascribe a relative score for each of these clearly discernible parameters in each PA. While some parameters are easily quantifiable, others are relatively intangible.

The scoring system forms a useful management tool. For example it can be argued that areas with higher than average conservation importance and higher levels of conflict should be provided more funds and more intensive management. On the other hand, if nothing is done to maintain PAs of a lower conservation status they will be degraded further, perhaps irretrievably. Adequately supported, these latter could become viable conservation sites. It would be, however, illogical to provide unnecessarily large funds for a PA of little conservation consequence, if high priority areas are left short of funds. An assessment based on the pattern evolved in this study, would help prioritize these issues.

The grading can also be used for selecting an appropriate strategy, from a set of broad management options, for each PA. This implies selecting a primary strategy from one of three management options - restoration, rehabilitation, and substitution of resources (Box 3). At times appropriate combinations of these in the form of primary and secondary management options may have to be used for different zones in the PA. The basic strategy may thus be supplemented by supportive measures in relation to the needs of the area. The management plan for the PAs must zone the area and the surrounding landscape types into different categories so that appropriate conservation actions can be initiated. This must take into account the utilization of the habitat by key wildlife and the conflict levels due to human activity. For example, Blackbuck (*Antilope cervicapra*) change their behavioural patterns in modified habitats. Elephants change their feeding behaviour in response to changes in the size of their habitat (Bharucha and Asher 1993).

This grading scale, using a selection of the most important and obvious parameters, is essentially aimed at formulating a model that can be extended to include a larger set of parameters based on detailed quantified field studies. It can also be used to select specific management strategies for individual PAs taking into account their relative status within the IPAS. The strategy would aim to develop an ecorestorative effort to bring about a high degree of 'naturalness'. It would also develop a parallel ecodevelopment plan to reduce biotic pressures on the PA (Gadgil 1987).

I. Rating PAs by their Objectives

The scoring system designed to rate an individual PA by its perceived objectives has been provided in (Table V).This has been used to evaluate each of the PAs and to provide a relative score.

Table V
NOTIONAL VALUES FOR RATINGS OF PA OBJECTIVES

Maximum value	Primary objective (4)	Secondary objective (3)	Tertiary objective (2)	Total (9)
Value of perceived objective				
Low grade	2	1	0	3
Moderate grade	3	2	1	6
High grade	4	3	2	9

Insert A : Specific Parameters

1	B	Preservation of high levels of Biodiversity (+ indicates highest estimated value)
2	E	Protection of Endangered species or Endemic fauna
3	P	Conservation of important Plant values
4	R	Preservation of Relict or threatened ecosystems
5	MUA	Multiple Use Area - fishing, fodder, etc.
6	S	Sustainable resource-use possibilities
7	L	Lake siltation prevention
8	W	Water regime protection from hill slopes
9	T	Used for Tourism: Over 20,000 per year - Primary objective 10,000 - 20,000 per year - Secondary objective 5,000 - 10,000 per year - Tertiary objective

TABLE VI
SPECIFIC OBJECTIVES

S. No.	Name	Primary		Secondary		Tertiary		Total Score
1	Radhanagari	B+ / P / E / R	4	W / L / (f-T)	2	Cr / Ex	2	8
2	Melghat	B / E / P / W	4	T / Ex	2	Cr / MUA	2	8
3	Tadoba	B / T / E	3	S / W / Ex	3	Cr / MUA	2	8
4	Bhimashankar	B+ / P / R / E	4	T / W	2	Cr / (f-S)	1	7
5	Nagzira	B / T / E	3	(f-S) L / R	2	Cr / Ex	2	7
6	Andhari	B / T / E	3	(f-S) / Cr / Ex	2	MUA / W	2	7
7	Navegaon	B / L / T	3	W / S / (f-Ex)	2	Cr / MUA	2	7
8	Koyna	B / L / P	3	T / W	2	(f-S)	0	5
9	Chandoli	B / R / P	3	E / T	2	(f-S)	0	5
10	Tansa	L / (f-T)	1	W / S / E	3	MUA	1	5
11	Sanjay Gandhi	L / T	2	(f-S) / W	1	Ex / Cr	2	5
12	Phansad	B+ / P / R	3	(f-T) / (f-Ex)	0	Cr / MUA	2	5
13	Chaprala	B / P / E / R	4	(f-T) / (f-Ex)	0	MUA	1	5
14	Pench	L / T / (f-S)	2	W / L	2	(f-Ex) / Cr	1	5
15	Painganga	B / E/ R	3	W / (f-T) / (f-S)	1	MUA	1	5
16	Malvan	E / R / P /(f-T)	3	MUA / (f-Ex) / (f-S)	1	Cr	1	5
17	Kalsubai	B / P / R	3	W	1	(f-T)	0	4
18	Karnala	T	1	Cr / W	2	Ex	1	4
19	Bor	B / (f-T) / E	2	S (f-Ex)	1	Cr	1	4
20	Aner Dam	W / R (f-T)	2	(f-S) / MUA / Cr	2	(f-Ex)	0	4
21	Gugamal	B / (f-S)	1	W / (f-T) / Cr	2	(f-Ex)	0	3
22	Gautala	B /P	2	(f-T) / (f-S)	0	MUA	1	3
23	Yawal	E / T	2	(f-S) / (f-Ex)	0	MUA	1	3
24	GIB	E	1	T	1	MUA	1	3
25	Jayakwadi	MUA / S	2	T / (Cr)	1	(f-Ex)	0	3
26	Nandur-Mad.	MUA / S	2	T / (Cr)	1	(f-Ex)	0	3
27	Sagareshwar	T	1	R	1	(f-Ex)	0	2
28	Katepurna	R / (f-T)	1	(f-S)	0	MUA	1	2
29	Rehakuri	E / R	1	T	1	(f-S)	0	2

10	Cr	Conservation research possibilities
11	Ex	*Ex - situ* Conservation possibilities
12	f	Future possibilities for 1 - 11**
*	G	General objectives of conservation (local, national and global concerns)

Insert B:

Primary objectives :
4 parameters = High grade
3 parameters = Moderate grade
2 parameters = Low grade

Secondary objectives :
3 parameters = High grade
2 parameters = Moderate grade
1 parameter = Low grade

Tertiary objectives :
2 parameters = High grade
1 parameter = Moderate grade
0 parameter = Low grade

**Note : These parameters represent perceived objectives that can be laid down for these PAs. Most of these are either being implemented or are being attempted. Those that can also be attempted by broadening the scope of the PAs objectives have been put into brackets and not used for the rating.

RATING ON THE BASIS OF PRIMARY, SECONDARY, AND TERTIARY OBJECTIVES

For an easily manageable scoring system, the primary objectives are limited to a maximum of four, secondary objectives to three and tertiary to two. Accordingly the relative scoring by the number of primary, secondary and tertiary objectives can be used to provide a grade and an index of the PAs rating by objectives (Table V).

The 'objectives' of an established PA play a

major role in influencing its evaluation. The aim of rational land use planning includes PAs as a vital component primarily to conserve biodiversity, and secondarily to sustainably manage renewable resources for the region. If a PA has a high probability of achieving several of these goals it is given a higher rating (Table VI). A lower rating is ascribed if it has only a few parameters. This is a reflection that the PA has a disturbed ecosystem or supports only a few species in an unnatural habitat. Areas such as Rehakuri, GIB Sanctuary, Sagreshwar and the man-made wetland PAs of Nandur and Jayakwadi thus have lower ratings based on objectives.

Grading for four important primary objectives gives a PA a greater value. Secondary or tertiary objectives, such as to provide economic benefits for surrounding people, or the availability of resources for human use, or its tourist potential, or the ability to enhance global environmental conditions, have been given a relatively lower importance. Each parameter has been separately evaluated and included to rate the PA's utilitarian functions at local or global levels.

Based on their perceived objectives, PAs such as Radhanagari, Melghat and Tadoba have the highest ratings. This group of very important PAs is followed by Bhimashankar, Nagzira, Andhari and Navegaon. PAs such as Koyna, Chandoli, Tansa, Sanjay Gandhi, Phansad, Chaprala, Pench, Painganga and Malvan are of the moderate group, while the rest are rated low for their objectives. Certain parameters are relatively fixed due to a PAs location, ecosystem type, size, etc. This can be said to give it a biogeographically fixed rating.

II. Rating PAs on Key Parameters

Biogeographical Rating

On the basis of biogeographical criteria PAs can be provided with a baseline rating in the IPAS, as follows :

(A) According to the proportion of land in PAs in different biotic provinces;
(B) The representation in different ecosystems; and
(C) Their relative sizes.

This is used to define their individual biogeographical rating in the network. These values are not affected by the level of management inputs and are thus relatively fixed.

A. The representation of the biotic provinces within the IPAS is used to provide a notional value of 3 for the areas where the representation is below the requirement of the IPAS, a lower value of 2 for those which have adequate representation and 1 for those that are over represented. This has been established in Table III and included in Table VIII (Column A).

B. The representation of different ecosystems in the 29 PAs is shown in Table III (Puri *et al.* 1983 p. 285). The number of PAs that protect different ecosystems is given in Table VII. The poorly represented ecosystems are given a higher notional value. These should be intensively protected. If the ecosystem is represented in less than 5 PAs the notional value given is 3; between 6 and 10 PAs, the value is 2; and in 11 or more, a value of 1. This score has been used to assess the rating for each PA (Table VII, Column B).

Table VII
NUMBER OF PAs THAT PROTECT DIFFERENT ECOSYSTEMS

Ecosystems	No. of PAs (A)	Notional Value (B)
Forest PAs		
Evergreen	3	3
Semi-evergreen	10	2
Moist deciduous	14	1
Dry deciduous	11	1
Thorn forest	1	3
Non-Forest PAs		
Grass and Scrubland	4	3
Wetlands	2	3
Marine	1	3

Note:- The total is over 29 as more than one system is represented in several PAs.

C. The relative importance in relation to size is shown in Table IV. The three categories are rated as follows:
Category I - Over 250 sq. km has a rating of 3;
Category II - 100 to 250 sq. km has a rating of 2;

TABLE VIII

BIOGEOGRAPHICAL RATING

	PAs	A	+	B	+	C	=	D	E
1	Radhanagari	2		3		3		8	3
2	Kalsubai	2		3		3		8	3
3	Bhimashankar	2		3		2		7	2
4	Koyna	2		2		3		7	2
5	Chandoli	2		2		3		7	2
6	Tansa	2		2		3		7	2
7	S. Gandhi	2		2		1		5	2
8	Karnala	2		2		1		5	2
9	Phansad	2		2		1		5	2
10	Chaprala	2		2		2		6	2
11	Melghat	1		1		3		5	2
12	Gugamal	1		1		3		5	2
13	Pench	1		1		3		5	2
14	Nagzira	1		1		2		4	1
15	Andhari	1		1		3		5	2
16	Painganga	1		1		3		5	2
17	Gautala	1		1		3		5	2
18	Yawal	1		1		2		4	1
19	Navegaon	1		1		2		4	1
20	Tadoba	1		1		2		4	1
21	Bor	1		1		1		3	1
22	Sagreshwar	3		3		1		7	2
23	GIB*	1		1		1		3	1
24	Aner	1		1		1		3	1
25	Katepurna	3		3		1		7	2
26	Rehakuri	3		3		1		7	2
27	Jayakwadi	2		3		1		6	2
28	Nandur	2		3		1		6	2
29	Malvan	3		3		1		7	2

A - Representation requirement in biotic province; **B** - Ecosystem representation; **C** - Size; **D** - Total; **E** - Average (to nearest whole number).
Higher values are given if Biotic province or ecosystem is relatively under represented.
* This rating considers the fact that most of the area is largely agricultural.

Category III - less than 100 sq. km with a rating of 1.

This is in accordance with the norms required for staffing of PAs laid down by the Government of India. However, these Categories could be further divided into IA, above 1000 sq. km. Category IB, 500 to 1000 sq. km, Category IIIA, 25 to 100 sq. km and IIIB - 1 to 25 sq. km. These subdivisions are essential for rating Protected Areas in relation to size. The values given for each PA for rating by size is given in Table VIII, Column C.

D. These 3 quantifiable values have been aggregated to rate the basic biogeographical value of each PA within the IPAS in Table VIII, Column D. The average rating for Conservation Potential for these three parameters has been rounded off to the nearest unit for each PA and is given in Table VIII, Column E.

Scoring criteria for three key issues based on specific parameters and management inputs

Assessing the degree to which each PA has achieved its objectives is difficult to quantify. An estimate in terms of its perceived objectives as against partially achieved or satisfactorily achieved targets is however possible. The success or failure of management requires a much greater degree of quantification and must be repeated periodically and as such has been only attempted here, during a brief period of three years. However, it has temporal implications over a much longer duration. It is possible that with good management these perceived objectives of a PA could be partially or eventually totally achieved, thus improving a PAs relative rating in the IPAS. If however, there is a progressive escalation of pressures, or poor management, the rating may be brought down on the evaluation scale.

The evaluation of the conservation and utilization potentials, as well as local conflict levels, in each PA, was strengthened by providing a score for these parameters under the three major heads as follows:

Protected Areas could have objectives that give them a conservation potential that ranges from a high to a low rating in the IPAS. A Protected Area could have few management problems, or have serious difficulties for its adequate management which could jeopardize its conservation status. Thus each PA may be placed in a matrix depending on the importance of its objectives and the level of management problems (See Box 2).

A matrix of possible combinations of parameters based on objectives and management problems which operate in a PA is shown in Table IX. It is evident that the preliminary scoring on objectives alone is inadequate for an objective

Box 2

Objectives	Low Level of Management Problems	Serious Management Problems
Highly rated PA	Continue existing Management	Improve management. Increase Resources. Increase Manpower.
Poorly rated PA	Continue existing Management	Lower objectives (or) Redesign (or), write off as a PA.

evaluation of a PA within the IPAS. Though the grading should be related to the relative importance of the objectives of a PA, its potential to achieve these goals is related to three key issues : (a) Conservation Potential; (b) Utilitarian Potential; and (c) Level of Conflict.

a) A large number of factors that cannot be easily quantified, must be considered for evaluating its Conservation Potential, such as its overall biological importance in terms of fragility and rarity of the ecosystem, the level of species richness and the presence of endangered or endemic animals and plants. Another factor that must be considered is the 'naturalness' of the ecosystem. Undisturbed natural forest must be rated higher than plantations. Fragmented or degraded PAs or those with high disturbance levels are given relatively lower ratings. Grasslands with a large number of grass species would be rated higher than those with high levels of pressure and few species in the ground cover.

b) The other factor for evaluating a PA is related to its ability to sustain human life. Their functions such as retaining soil, maintaining moisture regimes and providing for the daily needs of local people must be taken into account to grade the PAs. This needs a separate evaluation.

c) Finally, the interaction between the needs of conservation and the use of the area and its resources leads to different levels of conflict. The degree of these conflicts is related to the long term survival of the PA.

The guidelines used to give a score for these three key issues is given in Table IX. Using these graded criteria each PA has been given a score for Conservation, Utilization and Conflict Level, Table X. These values are reflected in Table XI for individual PAs.

III. Potential of PAs for Conservation, Utilization and the Conflict Level.

a) Conservation Potential: The conservation potential i.e. the Biological importance, 'naturalness' of vegetation and major wildlife values are given four grades, with values of 0 to 3, for each parameter (Table IX).

In the Conservation Potential a high rating is given to biological values such as the uniqueness of the ecosystem (Table III); the relative size of the PA (Table IV). The score in terms of biological value is reduced if similar ecotypes have been protected in other PAs (Table VII). An estimate of generally known species diversity; the presence of endangered species; and optimal habitat conditions to maintain wildlife populations provides a fair degree of the level of importance of a PA (Table XIa). The parameters used are thus Biogeographic importance, Naturalness of vegetation, Wildlife values which together provide a score from 0 to 9. The value is progressively reduced if the area is fragmented by other land-use patterns such as agriculture, plantations, etc.

b) Utilitarian Potential: The level of utilization of resources and the ecodevelopment possibilities in terms of providing timber, fuelwood, fodder and MFP as well as tourist facilities are given 4 grades (Table IXb). This provides scoring values of 0 to 3 for each parameter (Table Xb).

The values are influenced by the number of settlements within and on the borders of the PA and the pressure due to human and cattle populations. It also takes into account the existing management and the presence of interested Forest Department personnel and active NGOs who can collaborate in an ecodevelopment program.

TABLE IX

SCORING "VALUES" FOR ASSESSMENT OF THE POTENTIAL GOALS OF CONSERVATION/UTILIZATION/ CONFLICT LEVELS

"Values"	Grade I	Grade II	Grade III	Grade IV	Total
a) Conservation Potential - Biological Value					
Biogeographical Importance	Very important	Moderately important	Not significant	Biologically worthless	
Summation of Biotic ecosystem representation and size. (See Table VIII)	Distinctive ecosystem	Fragmented + ecosystem	Similar areas protected (Fragmented ++)	Totally degraded	
	Large size	Moderate size	Small size	Highly disturbed	
Plant values Habitat	Climax system	Marginally disturbed	Plantations Secondary	Highly disturbed	
	Optimum habitat for wildlife	Still very desirable for wildlife	Growth, sub-optimal habitat for wildlife	Intense human pressure	
	Very High Endemism and/or 'Naturalness'	Adequate Endemism and/or 'Naturalness'	Low Endemism and/or 'Naturalness'	Poor Endemism and/or 'Naturalness'	
Wildlife Values	High diver--sity Balanced population of prey and predator.	Highly man-managed to maintain balance. Signs of over abund--ance of wildlife.	Under-populated in relation to habitat. Requires better management.	Poor or absent. Severe people wildlife conflict	
	Endangered species ++	Important species +	Less important species	No important species	
	Increasing trend	Stable trend	Falling trend	Irreversible trend	
Score	Maximum	>	>	Minimum	X
b) Utilitarian Potential					
Timber	Exploitable areas present without degradation	Moderate potential due to past exploitation	Over exploited	Severely degraded No timber value	

Table IX contd.

"Values"	Grade I	Grade II	Grade III	Grade IV	Total
Food, Fodder, Fuel, marketable MFP	Exploitable without degradation	Exploitable with control and ecodeve-lopment input	Over exploited. needs large ecodevelop-ment input	Totally degraded	
Other Values Tourism Hydro	Correctly utilized	Underutilized	Overutilized	Adversely affects area.	
Catchment protection	Very important function	Moderately important function	Small function	No function	
Score	Maximum	>	>	Minimum	Y
c) Conflict level with proposed objectives	Minimal	Moderate	Severe	Very Severe	Score
Score:	Maximum	>	>	Minimum	Z

* Grade I provides the maximum 'value' while grade IV the minimum. An area would be graded in the format Conservation = X, Utilization = Y, Conflict level = Z.
The 'values' can be compared with other areas to place an area as: Highly desirable for conservation, significant, insignificant, or worthless.

TABLE X
SCORE VALUES FOR GRADES IN EACH PARAMETER

Scoring pattern	Grade I	Grade II	Grade III	Grade IV
a) Consevation potential				
1) Biogeographical importance	3	2	1	0
2) Plant or habitat values	3	2	1	0
3) Wildlife values	3	2	1	0
Total	9	6	3	0
b) Utilitarian potential	Grade I	Grade II	Grade III	Grade IV
1) Timber	3	2	1	0
2) Fuel, fodder & food	3	2	1	0
3) Other values- Tourism/ Catchment, etc.	3	2	1	0
Total	9	6	3	0
c) Conflict Level with proposed objectives	9	6	3	0

Note : For Conflict levels the highest score is 9 for Grade I which indicates minimal conflict, and lowest is 0 for Grade IV indicating maximal conflict.

The utilitarian potential is an indicator of the financial and infrastructural input that would be required for site specific ecodevelopment schemes that may help conserve biodiversity (McNeely 1988, p. 57). Baseline data on land and resource-use parameters were obtained from PA managers and through site visits (Annexure I, II). These are used for scoring Utilitarian Potential for each PA. A close interaction with local people to identify these baseline parameters is essential for evaluating the ecodevelopment potential of each PA. A Participatory Rural Appraisal is an essential interactive process before implementation of an ecodevelopment program. The human and cattle population density per hectare in a PA has been used as one index of the level of biotic pressure. Overall notional value for Utilitarian potential ranging from 0 to 9 is given for the PAs, (this data provided by PA managers provides an index of local management problems). The high pressure PAs with a human population of over 0.5 per hectare were given values as follows: Painganga - 1, Gautala - 1, GIB - 2 and Nandur - 5. Between 0.1 to 0.5 per hectare the values

TABLE XI
SCORING STATUS OF 29 PAs

Name of PA	(a) Conservation potential				(b) Utilitarian potential				(c) Conflict
	Biogeo. imp.	Nat. veg.	Wild. value	Total Score	Timber	Fuel, fodder, food	Tourism	Total Score	Score
Andhari	2	2	1	5	2	2	2	6	6
Aner Dam	1	1	2	4	1	1	1	3	5
Bhimashankar	2	3	2	7	2	1	1	4	3
Bor	1	2	1	4	1	1	1	3	5
Chandoli	2	3	1	6	2	1	1	4	4
Chaprala	2	2	2	6	1	1	1	3	3
Gautala	2	1	0	3	0	0	1	1	3
GIB*	1	0	1	2	0	0	2	2	1
Gugamal	2	1	2	5	2	1	2	5	5
Jayakwadi	2	1	1	4	1	1	2	4	2
Kalsubai	3	1	0	4	1	1	1	3	4
Karnala	2	1	0	3	1	1	1	3	4
Katepurna	2	1	0	3	0	1	1	2	3
Koyna	2	3	1	6	1	2	2	5	6
Malvan	2	2	3	7	1	1	2	4	3
Melghat	2	2	3	7	2	2	3	7	6
Nagzira	1	3	3	7	2	2	1	5	6
Nandur Mad.	2	1	1	4	1	1	3	5	2
Navegaon	1	3	2	6	2	2	1	5	3
Painganga	2	1	1	4	0	0	1	1	3
Pench	2	2	1	5	2	2	1	5	3
Phansad	2	3	1	6	1	2	2	5	6
Radhanagari	3	3	3	9	2	2	3	7	6
Rehakuri	2	0	1	3	1	1	1	3	1
S. Gandhi	2	2	1	5	2	2	1	5	3
Sagareshwar	2	0	0	2	0	0	2	2	3
Tadoba	1	3	3	7	2	2	1	5	9
Tansa	2	2	1	5	2	2	3	7	3
Yawal	1	1	0	2	1	1	1	3	5

Note:- Biogeo. imp.- Biogeographical importance Nat. veg.- Naturalness of vegetation; Wild. val.- Wildlife values; S.Gandhi - Sanjay Gandhi; Nandur Mad.- Nandur Madhmeshwar.

given were: Yawal - 3, Bhimashankar - 4, Aner - 3. PAs with less than 0.1 per hectare were given the following values: Melghat - 7, Andhari - 6, Pench - 5, Nagzira - 5, Navegaon - 5, S.Gandhi - 5 and Katepurna - 2. In several PAs precise figures were not available and population pressure was estimated by questioning people or by looking at PA maps and the number of settlements.

In response to questionnaires, PA managers also opined on the feasibility of establishing ecodevelopment programs. Some indicate a paucity of funds or expertise. The ability to produce adequate quantities of fuel and fodder is at best a guestimate and is related to factors such as the availability of land to develop the resource and the willingness of people to participate in joint management of PA resources.

It is obvious that in a PA only a very limited amount of timber extraction can be done so this must essentially provide an overall low rating. If a similar rating were to be used for a non-PA situation this would become an important index. Cattle grazing

TABLE XII

RANKING FOR DIFFERENT PA POTENTIALS

(a) Conservation Potential		(b) Utlitarian Potential		(c) Conflict level		Overall score		Rank (A)	Rank (B)
Radhanagari	9	Melghat	7	Tadoba	9	Radhanagari	22	1	1
Tadoba	7	Radhanagari	7	Melghat	6	Tadoba	21	2	3
Nagzira	7	Tansa	7	Andhari	6	Melghat	20	3	2
B'shankar	7	Andhari	6	Nagzira	6	Nagzira	18	4	5
Malwan	7	Gugamal	5	Koyna	6	Andhari	17	5	6
Melghat	7	Tadoba	5	Radhanagari	6	Koyna	17	6	8
Navegaon	6	Pench	5	Phansad	6	Phansad	17	7	12
Chaprala	6	Nagzira	5	Gugamal	5	Gugamal	15	8	21
Koyna	6	Navegaon	5	Yawal	5	Tansa	15	9	10
Phansad	6	Koyna	5	Aner Dam	5	Malwan	14	10	16
Chandoli	6	S. Gandhi	5	Bor	5	Navegaon	14	11	7
Gugamal	5	Phansad	5	Kalsubai	4	B'shankar	14	12	4
Andhari	5	Nandur	5	Chandoli	4	Chandoli	14	13	9
Pench	5	B'shankar	4	Karnala	4	Pench	13	14	14
Tansa	5	Chandoli	4	Painganga	3	S. Gandhi	13	15	11
S. Gandhi	5	Jayakwadi	4	Gautala	3	Bor	12	16	19
Jayakwadi	4	Malwan	4	Pench	3	Aner Dam	12	17	20
Aner Dam	4	Yawal	3	Navegaon	3	Chaprala	12	18	13
Bor	4	Aner Dam	3	B'shankar	3	Kalsubai	11	19	17
Painganga	4	Bor	3	Tansa	3	Nandur Mad.	11	20	26
Kalsubai	4	Kalsubai	3	S. Gandhi	3	Yawal	10	21	23
Nandur	4	Karnala	3	Chaprala	3	Jayakwadi	10	22	25
Rehakuri	3	Chaprala	3	Sagreshwar	3	Karnala	8	25	28
Gautala	3	Rehakuri	3	Katepurna	3	Painganga	8	24	15
Karnala	3	Sagreshwar	2	Malwan	3	Katepurna	8	25	28
Katepurna	3	GIB	2	Jayakwadi	2	Gautala	7	26	22
GIB	2	Katepurna	2	Nandur	2	Sagareshwar	7	27	27
Yawal	2	Painganga	1	Rehakuri	1	Rehakuri	7	28	29
Sagreshwar	2	Gautala	1	GIB	1	GIB	5	29	24
Median	5		4		4				

Note:- Rank (A) - Rank Achieved; Rank (B) - Rank on Perceived Objective (Table VI).
S. Gandhi - Sanjay Gandhi National Park; Nandur - Nandur Madhmeshwar; GIB - Great Indian Bustard Sanctuary; B'shankar - Bhimashankar.

also has a negative impact in most of the PAs. The sustainable collection of MFP is given a higher rating as it may not affect the PA adversely. Sustainable ecotourism is a potential source of income for local people and is thus included in the utilization aspect of the PA functions. The Utilitarian Potential with scoring for the 3 utilitarian parameters is given in Table XIB.

c) Conflict levels : The level of conflict between conservation goals and peoples' resource needs are given four grades. The minimum conflict level is given the highest rating and serious conflict the lowest.

Conflict levels are the most difficult to rate in the absence of detailed impact studies of the PA on the lifestyles of local people. Crop damage, cattle lifting, man kills, restrictions on the use of natural resources, access to markets, transport, water, etc. have been taken into account from the PA managers' responses to questionnaires. However, this would

need detailed PRAs for increasing the accuracy of evaluations. It may be noted that in the absence of a detailed PRA of all the settlements in and around a PA, ratings can be biased.

Each of the PAs have been given scores for different parameters (Table XI). Though it can be argued that the value selected in a certain parameter is subjective, this does not detract from its ability to help provide a comparison between different Protected Areas. It has been stated that " Quantifying conservation values is a complex and often subjective assessment" (Smith 1990). However a PRA can help to reduce the bias by conversing with a large number of people, both from the management personnel as well as local people and NGOs.

Note : The biogeographic ratings for PAs are given out of a total of 9 (Table VIII). This is averaged to the nearest whole number as the scores for biogeographical importance and included in Table XI which is rated from 0 to 3. The biological importance not only takes into account the biogeographical rating but considers a variety of other factors. These are 'distinctiveness' of the ecosystem; guestimates of the level of biodiversity and the known number of endemic or endangered species. The utilitarian values are also built up through a variety of separately quantifiable values to develop an overall score for each PA. The Conflict Levels are a reflection of the interaction between the management established for a PA and the needs of local people. All three have been aggregated into an overall score in Table XII.

Table XI shows the values given in each parameter to the PAs, and the score for their Conservation Potential, Utilization Potential and Conflict Levels. Whereas some PAs have better aggregate scores for their conservation potential others have greater utilitarian value with the ability to support people through ecodevelopment programs. Still others have lower levels of conflict with proportionately higher ratings in this vital component.

Table XII shows the rating for each aspect of a PA's function in order of merit. This shows that ranking varies considerably in each data set. The median value for conservation potential is 5, for utilitarian potential 4, and for conflict level 5.

For example - the highest ratings for the Conservation Potential is for Radhanagari - 9; Tadoba -7; Nagzira - 7 and Malwan -7. In terms of their ability to support their Utilitarian Potential for different functions and an ecodevelopment program the highest scores are found in Melghat - 7; Radhanagari - 7; and Tansa - 7. The Conflict Level is minimum in Tadoba - 9; as there are no settlements within its boundaries.

Adding these together to provide a total overall score for the status of the PAs shows that Radhanagari has 22, and Tadoba - 21; followed by Melghat - 20; and Nagzira - 18. This however gives little indication of the status of a PA. Aggregating the individual scores of Conservation, Utilization and Conflict Levels do not give a clear picture of the different aspects necessary to evaluate the success level achieved for a specific PA in the IPAS.

An unusually low scoring is ascribed to the GIB sanctuary with a Conservation Potential score of 2, a Wilderness Utilization Potential of 2, and its Conflict Level with a score of 1. The overall score is 5 showing that though this PA is created for the highly endangered Great Indian Bustard, in its present form it is not of much significance. If however, the rating of only Nanaj and a few other pockets having this endangered bird is considered , i.e. 400 sq. km out of the present 8,496 sq. km, the rating would be different. The Conservation Potential would be 6, the Utilization Potential 6 and the Conflict Level 6, i.e. an overall aggregate score of 18. This would place it among the more valued PAs. The example of the GIB sanctuary illustrates how scoring on a conservation evaluation scale can influence management of PAs and help redefine boundaries if necessary.

An important observation is the change in the rating of individual PAs observed in Table V, which provides a score for perceived objectives and that actually achieved in Table XII. The shift can be related to a variety of issues due to which perceived objectives of the Bhimashanker Sanctuary gave it a

Table XIII
SCORES OF CONSERVATION, UTILISATION AND CONFLICT LEVELS AND PA SIGNATURES

Name of PA		Conservation level (A)	Utilitarian level (B)	Conflict level (C)	Signatures ** A	B	C
1	Radhanagari	9	7	6	+	+	+
2	Melghat	7	7	5	+	+	+
3	Tadoba	7	5	9	+	+	+
4	Koyna	6	5	5	+	+	+
5	Phansad	6	5	5	+	+	+
6	Nagzira	7	5	5	+	+	+
7	Andhari	5	6	6	0	+	+
8	Gugamal	5	5	5	0	+	+
9	Navegaon	6	5	2	+	+	-
10	Chandoli	6	4	4	+	0	0
11	Bhimashankar	7	4	3	+	0	-
12	Malwan	7	4	3	+	0	-
13	Pench	5	5	3	0	+	-
14	Tansa	5	7	3	0	+	-
15	S. Gandhi	5	5	2	0	+	-
16	Chaprala	6	3	3	+	-	-
17	Nandur Mad.	4	5	2	-	+	-
18	Jayakwadi	4	4	2	-	0	-
19	Bor	4	3	4	-	-	0
20	Aner Dam	4	3	4	-	-	0
21	Yawal	2	3	3	-	-	0
22	Kalsubai	4	3	4	-	-	0
23	Karnala	3	3	4	-	-	0
24	Katepurna	3	2	4	-	-	0
25	Painganga	4	1	3	-	-	-
26	Gautala	3	1	3	-	-	-
27	Sagareshwar	2	2	3	-	-	-
28	Rehakuri	3	2	1	-	-	-
29	GIB	2	2	1	-	-	-

Note: +: Above median, 0: Median, -: Below median.
** Low conflict levels have high notional values. High conflict levels have low notional values.

rating as the 4th in the IPAS. However the aggregated score for conservation, utilization and the conflict level patented gives it the 4th rank (Table XII, column A), it falls to 14th and 19th place in the Utilitarian Potential and the high conflict level. Thus the perceived objectives appear to be biased by its high biological value. The disparity between perceived objectives (Table V) and the achieved ranking (Table XII) can be evaluated for each PA in Table XII.

Overall Score and Individual Rating

Table XII shows that the PAs can be divided into 3 major groups. Those having scores for conservation, utilization and conflict levels above the median value, those of a median value and those that have ratings below the median value.

In Table XIII, those with a score above the median value are given a '+' sign, the median value is given a '0' sign, while those below the median value are given '-' sign, for each data set. Accordingly, the combinations possible are 3^3 and a PA could have one of 27 different combinations (Table XIV, Column A). Of these the PAs fall into 11 categories, i.e., the existing signatures (Table XIV, Column B).

Thus each PA has its own 'Signature' depending on its relative status in the IPAS. This

Table XIV
SIGNATURE OF PAs IN THREE GROUPS

(A)	(B)	Signature	PAs
		Group I: 7 PAs	
1	1	(+++)	Radhanagari, Melghat, Tadoba, Koyna, Phansad and Nagzira
2		(++0)	
3		(+0+)	
4	2	(0++)	Andhari, Gugamal
5	3	(++-)	Navegaon
6		(+-+)	
7		(-++)	
		Group II: 5 PAs	
8	4	(+00)	Chandoli
9		(0+0)	
10		(00+)	
11	5	(+0-)	Bhimashankar, Malwan
12		(+-0)	
13		(0+-)	
14		(000)	
15		(0-+)	
16		(-+0)	
17		(-0+)	
18	6	(00-)	Pench, Tansa, S. Gandhi
19		(0-0)	
20		(-00)	
		Group III: 17 PAs	
21	7	(+--)	Chaprala
22	8	((-+-)	Nandur Mad.
23		(--+)	
24		(0--)	
25	9	(-0-)	Jayakwadi
26	10	(-0)	Bor, Aner, Yawal, Kalsubai, Karnala, Katepurna
27	11	(---)	Painganga, Gautala, Sagreshwar, Rehakuri, GIB.

* (A) - Possible Signatures
(B) - Existing Signatures

method of rating can be used to indicate the best management options for individual PAs, and is a better indicator for selecting management options than the overall score. Table XIV shows the 'signatures' of each PA.

In the 3^3 , i.e. of 27 possible combinations that form a 'signature', there are three major groups:

Group I has either 3(+); or combinations of 2(+), with 1(0); or 2(+) with 1(-);

Group II has combinations of 1(+), with either 2(0); or 1(+), with 1(0) and 1(-); or 3(0)s.

Group III has combinations of 2(-) with 1(+) or 1(0), and 3(-)s (Table XIV).

Thus there are 8 PAs in Group I; 8 in Group II; and 13 in Group III. This gives a clear indication of the status of the PAs within the IPAS.

INTERPRETATION

(a) Conservation Potential

In the signature, a (0) for conservation would indicate an average placement in the IPAS. If a (+) sign is given for conservation this would necessitate a policy towards establishing an area with the highest level of protection and to 'restore' it to a level of being considered as a 'Strict Nature Reserve' by IUCN standards. A (-) sign would indicate a low conservation status. Here hard decisions must be made, as it may become essential to write off some of the least significant areas. No large financial outlays should be made for such areas under normal conditions. An exception would be the presence of an endangered species not found elsewhere, or some other specific objective that the PA is intended to protect or preserve.

(b) Utilitarian Potential

If for utilization a (0) is ascribed, these PAs would require an average outlay of the budget towards ecodevelopment which could be expected to maintain the ecosystem in its present state. A (+) sign indicates that pressures are low and if the financial input is adequate one can expect an improvement in the state of the ecosystem. Here the management must aim towards balancing conservation and utilization to provide a "rehabilitation" program to achieve a desired level of 'naturalness'. A (-) sign for utilization indicates a high resource pressure. Here the major thrust should be to "substitute" resources developed in external buffers. This also may need high economic support if the conservation potential shows a (+) sign. Several of these areas, however, may have to be managed as "Multiple Use Areas" as defined by IUCN.

(c) Conflict Levels

Finally, if the conflict sign is (0,) this is indicative of the average level of man-animal conflict, or between the needs of conservation of biodiversity, with natural resource use by local people in the PA. A (+) sign indicates lower than average levels and signifies good long-term possibilities for conservation. These are the areas where the local acceptance of the PA is likely to be most easily achieved. A (-) indicates a serious issue that would require a larger financial outlay towards compensating for losses (due to crop damage, cattle lifting, etc.). A major thrust of management in this situation must aim at reducing the conflict both within and on PA boundaries.

THE 'SIGNATURE' AND MANAGEMENT ISSUES

The signature is an aid for selecting management options and designing management plans for PAs. Of the 27 options available, the PAs fall into 11 patterns. These form three distinct groups see Table XIV. The issues that are to be taken into account relate to the preservation of biodiversity at species and landscape level and their relationship to specific local factors (Box 5).

1. (+++): Of the 29 PAs six have a (+++) signature (ie. 20.69%). The signature pattern (+++) indicates above average scoring for all three major criteria. In this group the possibility of restoration appears most feasible. The aim of management should be to create as large a core as possible with ecodevelopment inputs for conserving the buffer on a sustainable basis. The low conflict level is a distinct advantage, making restoration an attainable target. This strategy must thus be used to evolve management plans for Radhanagari, Melghat, Tadoba, Koyna, Phansad and Nagzira. Tadoba is the only National Park in this group. Thus Radhanagari, Melghat, Koyna, Phansad and Nagzira Wildlife Sanctuaries should be upgraded to NP status, to provide inviolate cores and better management. This would ensure their preservation on a long term basis. Melghat is of great conservation significance due to its large size, especially as tigers need large areas.

2. (0++): There are two PAs in this group (6.9%). The (0++) signature is given for PAs that may not have a very large conservation significance. However, with their relatively good ecodevelopment potential and low conflict levels, they may retain their present conservation status. These are Andhari and Gugamal.

3. (++-): In the 29 PAs only one had this signature (3.4%). In the signature pattern of (++-) though the conservation and utilization potentials are above average, the high conflict level may make restoration an unattainable and unpopular goal. Here the individual cause of conflict in each case would have to be addressed as a primary concern of management planning. Navegaon has a Naxalite problem with an otherwise high potential for long-term conservation.

4. (+00): Chandoli is the only PA in this group. This PA has a high conservation potential with average ecodevelopment possibilities and moderate levels of conflict. Chandoli in the Western Ghats is an important ecotype.

5. (+0-): This category has two PAs (6.9%). Malwan has a great conservation significance, being the only marine PA (3.4%). However, conflict with local fishing rights is a major issue. Bhimashankar has a very high biological significance as it is situated in a 'hot spot' of biodiversity. Local conflict issues which have been triggered off by local politically active NGO groups is a significant conflict triggering factor. This appears to have escalated problems instead of eliciting cooperative joint PA management with local people.

6. (0+-): There are three PAs in this group (10.3%). A (0+-) signature signifies a PA of average importance where ecodevelopment is feasible but conflict levels are unduly high. The management must thus focus on primarily reducing conflict. S. Gandhi NP is a problem PA due to the leopards which have been known to attack people living in the nearby slum.

7. (+--): This group has only one PA (3.4%). In the (+--) group Chaprala, though of considerable conservation significance has problems both due to

human activity and resource pressure, as well as serious conflict. Management must thus attempt to preserve its high conservation value by providing alternate resources through ecodevelopment and minimizing conflict.

8. (-+-): In the 29 PAs 1 (3.4%) is in this group. The signature (-+-) indicates that the conservation potential is below average, the utilitarian potential is high and conflict is a serious issue. Here, restoration would in fact be unnecessary and may require inordinately high inputs if it were to be attempted. A more objective rehabilitation program might be a better management option. Nandur could thus form an ideal MUA as recommended for the proposed PA at Ujjaini (Bharucha and Gogate 1990).

9. (-0-): There is only one PA in this group (3.4%). Jayakwadi is a man-modified wetland system of low conservation value as a landscape type, however, it supports a large number of wildfowl.

10. (--0): There are six PAs in this group (20.69%). Those PAs which have a signature (--0) have a low conservation potential with low utilization potential and moderate levels of conflict. Management planning must focus on a good substitution program for resources and identify those that have specific conservation objectives. Bor, Aner, Yawal, Kalsubai, Katepurna and Karnala are included in this group.

11. (---): This group has 5 PAs (17.24%). The signature (---) has low conservation as well as utilization potentials and serious conflict levels. Included in this group are Painganga, Gautala, Sagreshwar, Rehakuri and GIB. These are problem areas which would require rehabilitation and a large substitution complement. The high conflict level would probably negate all efforts at conservation unless rapidly defused. These PAs require careful management if they are to play any role in the conservation of biodiversity in the State. Some may require a modification of their size, or a re-demarcation of boundaries. In others, serious people - wildlife issues may have to be solved. At present most of these can at best be looked upon as MUAs. The GIB Sanctuary is too large to manage and is primarily not a wilderness area and thus cannot be rehabilitated or restored. Rehakuri is too small for long-term viability, especially due to serious conflict due to crop damage by Blackbuck. Sagreshwar, though in a forest type not found in any other PA in Maharashtra, is of little conservation significance. In future some of the PAs in this group may have to be redesigned or their objectives lowered, so that their proposed objectives can be achieved.

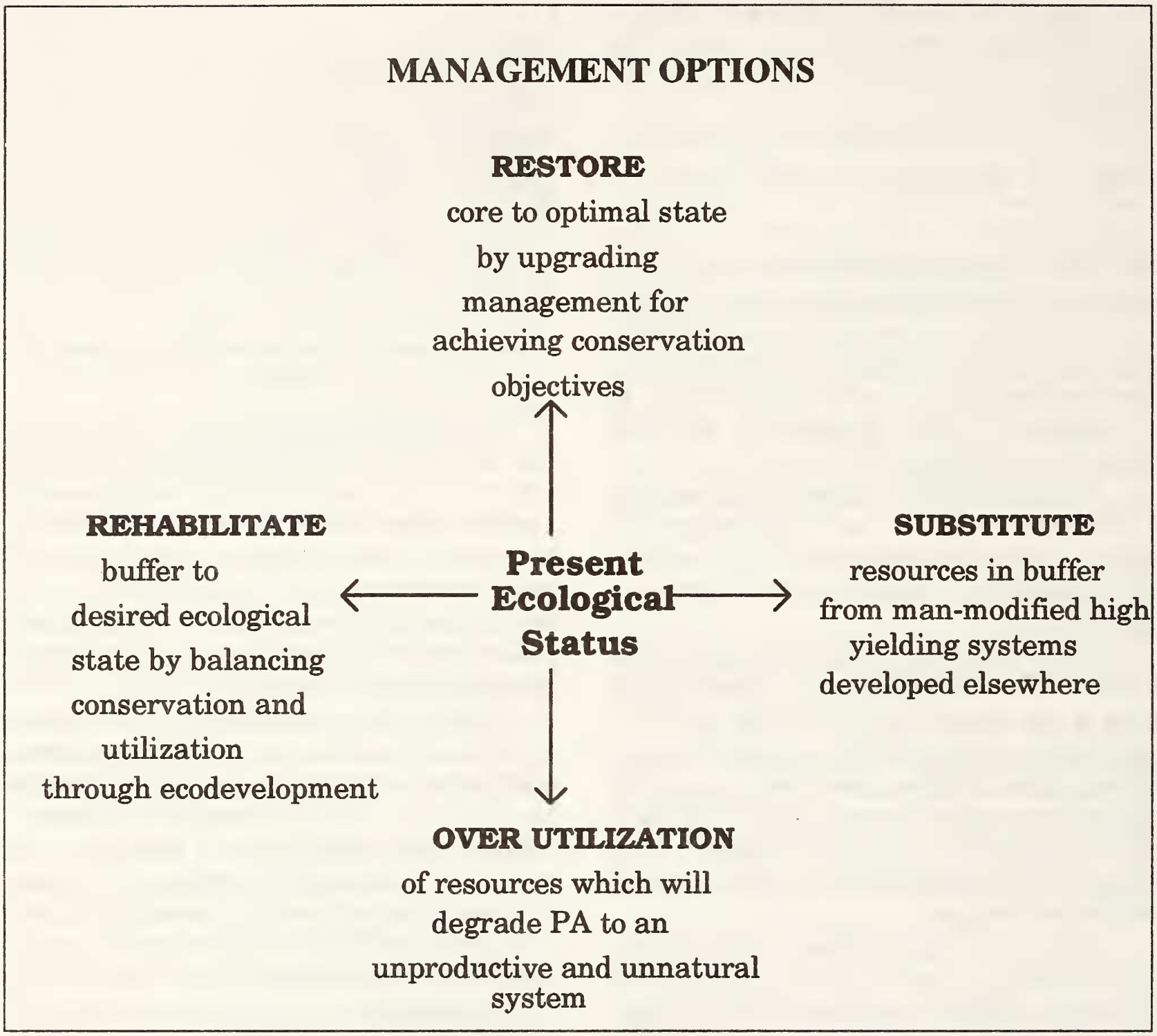
Implications of Scoring on Management of PAs

The ratings provided for PAs on the basis of their objectives alone do not necessarily coincide with the ratings based on the three parameters identified as the most important criteria for assessing PAs, namely the Conservation Potential, Utilitarian Potential and the degree of Conflict. This indicates the need for specific management to achieve these goals, or to modify objectives where the probability of achieving them is not feasible.

The basic policy for management of PAs must consider their specific objectives. In important PAs management must attempt to recreate a relatively 'natural' state of the ecosystem in its 'climax' vegetation form. This process of restoration may not be an achievable target in all cases. In certain situations it may not even be a desirable objective as it may be detrimental to certain important species found in non-climax communities. However, this must be attempted in the core areas of most NPs and the more important Wildlife sanctuaries (Box 3 and 4).

A PA's management may only be able to bring about rehabilitation of its ecosystem to achieve a desired level of naturalness. Here its conservation goals and utilization capability are to be balanced judiciously (Box 3 and 4). This option attempts to provide a sustainable use of local resources while maintaining the wilderness in as optimal a state as possible. The process of ecodevelopment and spatial zoning of the PA for resource-use are important management strategies for this option.

Box 3



In PAs where restoration or rehabilitation, along with sustainable resource utilization, is beyond the carrying capacity of the PA, or if it is likely to erode its resources if over exploited for subsistence needs of local people, these resources must be developed elsewhere and met through substitution. Providing these additional resources is the price that society must pay for the preservation of PAs. This is frequently neglected and it is invariably the poor wilderness dweller who pays the price of conservation. This must be rectified by adequate financial inputs into the IPAS to support people whose resource-use has been restricted to achieve conservation gains. However, this should not be provided in a monetary form but by creating opportunities for achieving a higher socio-economic stability, based on activities that do not place further pressures on the ecosystem.

A combination of basic and supportive management options may be necessary to achieve conservation goals. Different objectives of management must also be specified for core and

buffer zones (Box 3 and 4). This has a bearing on the financial outlay for adequate management for restorative and ecodevelopment activities (Box 4).

In terms of management for PAs that have a relatively High Score for their Conservation Potential the ideal method would be to attempt to restore at least a part of the area - the core - to near 'natural' conditions. However, this would depend on the capability of its buffer to have an adequate Utilization Potential so that resource needs can be provided for local people. This could be achieved by rehabilitation of the buffer area. All PAs of a NP status should be able to fulfill this function.

If the PA's ability to support the peoples' basic needs has a relatively Low Score it would be essential to substitute resources from outside the PA. PAs with more serious conflicts require increased financial outlay, larger resource substitutions and more sensitive management. Management strategy must counteract the polarization of the needs of wildlife conservation and those of local people.

The graded system of ascribing scores to PAs provides an important indiactor of the relative status of each PA. This in turn can be used to help select basic management criteria for the individual PAs within the IPAS.

A more detailed and accurate grading could be achieved if several other parameters are quantified and included in the grading scale. In Conservation Potential, apart from factors such as size, biogeographic and ecosystem representation, other factors such as shape, habitat quality, statistically quantified faunal populations and the degree to which species are locally endangered, could all be studied and given a proportionately justifiable weightage. In the Utilization Potential the scoring has taken into consideration parameters such as number of settlements/sq. km and human population density. It should also consider their spatial distribution, the amount of 'malki' land, number of free ranging cattle, the extent of dependence on minor forest produce, etc. which must be graded during a detailed Participatory Rural Appraisal. The type and pattern of tourist pressure must be studied to see if it is within the tourist carrying capacity of the PA. Providing smaller individual units for Conflict levels such as the estimated value of the crop damage, lifting of livestock, and the loss of life and livelihood must be included. However, these issues are difficult to quantify, especially when attempting to put a value on human life. An important objective of a more detailed analysis would be to decide which areas can be included in the Scientific Reserve/Strict Nature Reserve category as per the IUCN, and which areas require a change from Wildlife Sanctuary to National Park status. Other categories such as 'Resource Reserves' or 'Multiple Use Areas' could

Box 4

COMBINED MODES OF MANAGEMENT

	OPTIONS	BASIC MANAGEMENT	SUPPORTIVE MANAGEMENT
Most valued PA	1	RESTORE core +++	RESTORE buffer ++
	2	RESTORE core ++	REHABILITATE buffer +
	3	REHABILITATE core +	SUBSTITUTE resources for buffer (+++)
Least valued PA	4	SUBSTITUTE for whole PA (+++)	

+++ : High financial inputs on ecorestoration.
++ : Moderate financial inputs on ecorestoration.
+ : Low financial inputs on ecorestoration

(+++) : High financial inputs on ecodevelopment
(++) : Moderate financial inputs on ecodevelopment
(+) : Low financial inputs on ecodevelopment

Box 5

BIODIVERSITY PRESERVATION

Species level → Preservation
- → Waterfowl breeding areas (Ujjaini)
- → Wolf, endemic fish (mahseer), Giant squirrel
- → Western Ghats flora
- → Major Predators (Tiger, Leopard)
- → Western Ghats Amphibia
- → Medicinal Plants

Landscape Level
- → Semi - arid grasslands (After reduction of GIB) → Notify other grasslands a) Semi-arid b) Coastal
- → Western Ghats forests → New PAs: Mahableshwar, Fr. Santapau; Corridoring existing PAs
- → 'Unique' areas; → Coral reef, mangrove, coastal grasslands,marshes; Bird breeding colonies, marine flora and fauna

LOCAL FACTORS

GIB → Extremely large unviable PA → Reduce in size → Local requests for MIDC

All Western Ghat PAs → Fragmentation → Establish Corridors (Convert RF to PA status)
High Biodiversity No timber value in ESAs

Wetland PAs → Conflict with Fishing

All Forest PAs
- → Crop Damage by Wild Boar and Deer
- → Conflict due to free grazing by scrub cattle

Melghat → Proposal for reduction in size → Inadvisable → Largest viable Protected Area
Tigers need large home ranges

Malwan → Severe conflicts with fishermen → Specific ecodevelopment
Only known coral reef

Phansad → Small size → Increase size
Only Protected Area with primarily a coastal forest, etc.

Bhimashankar → Devarais → Triggered Conflict

Radhanagarri → Threatened by Mining

Koyna → Relocation of Settlements

Sanjay Gandhi → Human Encounters with Leopards

Rehekuri, GIB → Crop Damage by Blackbuck

Navegaon → Naxalite Problem

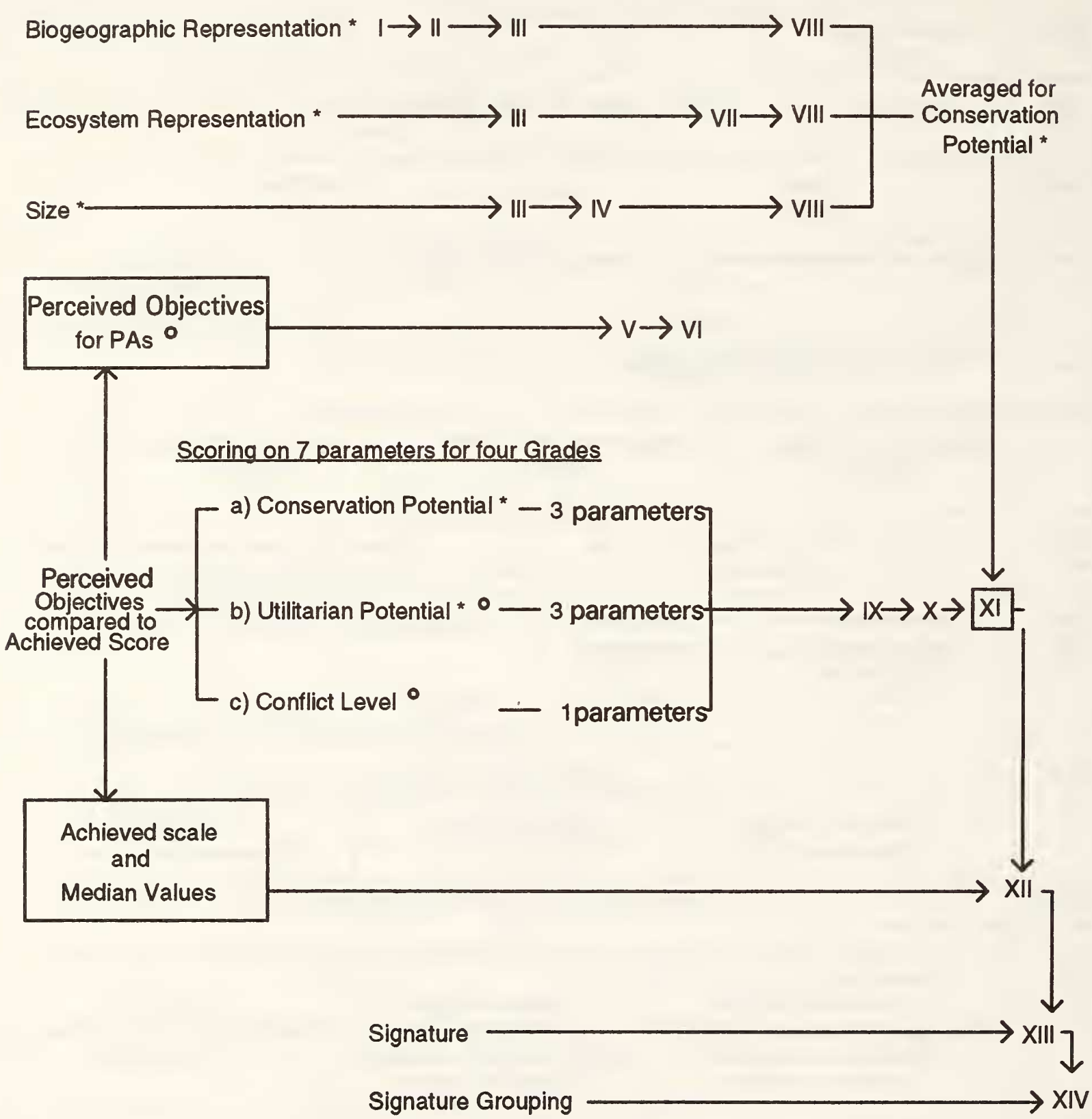
IMPRESSIONS

EVOLUTION OF THE NOTIONAL VALUES

Table I	Biotic Province	Total landmass of Maharashtra (sq. km)	(A) % in each biotic province	Area under PA at present (sq.km) (sq. km)	(B) % of area in PA network	Area in PA if GIB reduced in size	(C) % of area in PA network GIB	
Table II	Biotic Province (Table I)	A		B	B-A	C	C-A	Value 1-3
Table III	Ecosystems	PA	Status	Size	Biotic Province (Table II)	Ecotype	Number of PAs	
Table IV	Size (Table II)	Notional Value 1-3						
Table V	Specific Objectives (Perceived)	Score based on 12 parameters	0-3 : High Grade 4-6 : Moderate Grade 7-9 : Low Grade					
Table VI	Value for Objectives - Grading Method							
	Maximum no. of Primary Objectives 4	Maximum no. of Secondary Objectives 3	Maximum no. of Tertiary Objectives 2	Total 9				
Table VII	Number of PAs of Different Ecosystems (Table III)	Notional Value based on common/rare types 1-3						
Table VIII	Biogeographic representation in biotic province (Table II) 1-3	Ecosystem representation (Table VII) 1-3	Size (Table IV) 1-3	Total 3-9	Average 1-3			
Table IX	Scoring Values - 7 Parameters							
	Conservation Potential (3 parameters: 0-3)	Utilization Potential (3 parameters: 0-3)	Conflict Level (Opportunistic parameters: 0-3)					
Table X	Score Values for 4 grades for each Potential 0-9							
Table XI	Scoring Status Conservation Potential Biogeographic Importance (Table VIII) Natural Vegetation/Wildlife (Subjective estimates)	Utilization Potential Timber (Questionnaire) FFF (Human/Cattle Population) Tourism (No. per year)	Conflict Level Human/Cattle kills, Crop damage, etc. (Questionnaire)					
Table XII	Ranking Status PA Name Conservation Potential (Table XI) Median Value-5	Utilization Potential (Table XI) Median Value-4	Conflict Level (Table XI) Median Value-4	Rank Achieved	Rank Perceived (Table V)			
Table XIII	Conservation (Table XII)	Utilization (Table XII)	Conflict (Table XII)	Signature				
Table XIV	Signature Grouping	Grade I: Good	Grade II: Average	Grade III: Poor				

EVOLUTION OF THE RATABILITY OF PAs BY SCORING

(Information transfer through Tables to achieve a high degree of rating sensitivity



* - Information based on hard data

° - Information based on Questionnaires and Opportunistic Observations

also emerge from a more detailed study and help to formulate a graded management strategy for the PAs in relation to the needs of the IPAS.

This study indicates that a rational, progressively developed scaling system of assessment could be a valuable management tool if evolved further along the lines suggested. Scoring systems cannot be perfect, as some of the parameters must be based on subjective impressions. This limitation is inherent to such an exercise. The only possible method of reducing this bias is by consciously avoiding a personal evaluation of the overall rating of a PA. A consensus of views from different experts and multiple quantified parameters would make it more objective.

A more detailed field survey system could be evolved, that would assess the conservation potentials, utilitarian potentials and the conflict levels in as short a period as possible. Evolving such 'Rapid Assessment Techniques' (R.A.T.) for both conservation status and socioeconomic conditions has been attempted in a pilot study of the Bhimashankar sanctuary (Bharucha 1991).

The complexity of using a larger number of parameters for evaluating large numbers of PAs is that it would require a computer model designed specifically for this purpose. The exercise would be invaluable in rating PAs in the IPAS and in

Annexure I

HUMAN AND CATTLE POPULATION INSIDE PROTECTED AREAS

Responses from PA managers to assess human population pressure and cattle grazing.

Name of PA	Size in ha.	Human Population 1971	1981	/ha	Cattle Population 1971	1981	/ha	Agri area in ha.
Forests - Western Ghats								
Radhanagari	35100			-			-	
Kalsubai	36200			-			-	
Bhimashankar	13100	-	2879	219	-	3520	0.268	5127
Koyna	41900			-			-	
Chandoli	30900			-		-	-	
Sanjay Gandhi	10300	-	924	0.089	-	-	-	-
Phansad	7000			-			-	-
Karnala	400	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Forest-N & NE								
Melghat	161600	-	16120	0.099	-	1063	0.130	10984.6
Pench	25700	460	680	0.026	411	498	0.019	32.5
Nagzira	15300	-	306	0.02	-	201	0.013	90.2
Andhari	50900	1851	1757	0.034	1728	2254	0.044	433
Painganga	32500	-	21781	0.670	-	14886	0.458	17922.6
Gautala	26100	-	17526	0.671	-	17403	0.666	23698.7
Yawal	17600	-	1943	0.110	-	1942	0.110	611
Navegaon	13400	-	290	0.021	-	582	0.043	229.5
Tadoba	11700	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Grassland and Scrubland								
GIB (only part)	849600	621000	882359	1.038	658583	721290	0.848	10384
Aner Dam	8300	940	1887	0.227	400	464	0.055	257
Katepurna	7400	-	425	0.057	-	471	0.063	1525.8
Rehakuri	200	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Wetlands								
Nandur-Madhmeshwar	10000	-	19424	-	-	-	-	

Note:- Protected Areas and Wildlife Conservation in Maharashtra, E.Bharucha - A Report for the World Bank, 1991.
The data is incomplete. As in some cases settlements which are located within the PA have been excluded from the notification.
(Source:-Protected Areas and Wildlife Conservation in Maharashtra E.Bharucha - A Report for the World Bank, 1991)

Annexure II
FUEL AND FODDER
RESPONSES FROM PA MANAGERS TO ASSESS FUEL AND FODDER NEEDS OF SETTLEMENTS

Name of PA	FUEL	FODDER
Forests Western Ghats		
Radhanagari	Locally, pvt. forest	Locally
Kalsubai	From PF	Pvt. land & Plantation
Bhimashankar	Malki & forest	Malki area
Koyna	Own area	Own area
Chandoli	Malki & forest	Malki area
Sanjay Gandhi	From PA	From PA
Karnala	PA & Panvel range	Varkas and pendha
Phansad	Malki land & PA	Govt. Forest
Forests N & NE		
Melghat	Forest area	Forest area
Pench	Adjoining Areas of PA	From PA
Nagzira	Agri. waste, Forest area & PA	PA, Forest & Pvt. Land
Andhari	Pvt. land, Forest area & depot	Forest area & Pvt. Land
Painganga	Pvt. land & PA	From PA
Gautala	Pvt. land & PA	Pvt. land & PA
Yawal	From PA	From PA
Navegaon	From PA and Adjoining forest	From PA and Adjoining forest
Tadoba	(No villages)	(No villages)
Grassland and Scrubland		
Sagarehwar	(No villages)	(No villages)
GIB	Malki & market	Gairan, pvt. & market
Aner Dam		
Katepurna	PA	PA
Rehakuri	(No villages)	(No villages)
Wetlands		
Nandur-Mad.	Private land	

Note:- Protected Areas and Wildlife Conservation in Maharashtra, E.Bharucha - A Report for the World Bank, 1991.

providing the basis for rational management and financial disbursement to the component PAs.

This study which has been based on 29 PAs of Maharashtra, thus could form a model for a larger analysis. Similar studies could thus be undertaken for the more than 500 PAs now notified in India, to provide an overall picture of the status and position of each PA in the country.

Conclusion

An IPAS designed for Maharashtra must have an implementable strategy (Annexure III). Apart from preserving biological diversity and natural ecosystems, it must protect soil and water regimes, provide for the needs of the surrounding local people and thus gain acceptance as a necessary part of good land use planning (Conserving the Worlds Biological Diversity, 1990; Caring for the Earth, 1991). It must also consider the financial implications of setting aside land for conservation (Smith 1990, Phillips *et al.*, Dixon and Sherman 1990, Calish *et al.* 1978). The possible changes that must be considered are indicated in Annexure IV.

As shown in Part A, the selection of existing PAs is not based on objective criteria. They do not constitute a rationally designed IPAS for Maharashtra. The status and size of some PAs should be redefined according to the set of principles enumerated above. Size alterations are also indicated. Besides this, several new PAs need to be notified and their specific objectives clearly defined (Rodgers and Panwar 1988). The PAs must fit into the overall IPAS and funds be allocated in accordance with their relative merits and importance (Kothari *et al.* 1989).

Part B of this paper shows that the components of the IPAS, i.e. the existing PAs require to be based on a rational set of management options. This would indicate the amount of manpower and financial support necessary for achieving their perceived objectives. At present the distribution of both appears to be on an *ad hoc* basis, with no relevance to the needs of individual PAs. Identification of the relative position and status of a PA, based on its rating in the IPAS, provides rational guidelines to select the policy most relevant to its management. Financial resources can be more rationally utilized according to these priorities. At present the only guidelines from the Government of India are based on the size of the PA which is seen to be irrelevant. If this were to be followed, 50% of the Wildlife Wing staff would have to be

deployed to guard agricultural crops in the Great Indian Bustard Sanctuary, as this constitutes 50% of the IPAS! They would be looking after about a dozen highly localized and seasonal bustards, while the rest of the 28 PAs would be left to fend for themselves!

Since nearly all the existing PAs have a large number of local people who are highly dependent on their resources for their daily needs, especially for fuelwood and fodder, this requires a totally new management approach. This is even more relevant in Maharashtra due to the absence of alternate land for resettlement of PA villages. Though there is little scope for relocating them outside PAs, providing alternate locations within the PA is however a possible option. This is especially relevant in situations in which people are themselves keen to move to a more suitable location. Reducing the human impact on the PA must become a prime issue for successful implementation of the IPAS. This needs comprehensive, site specific, ecodevelopment programs that must be integrated into the Management Plan of each PA. It is essential to identify the quantum of resources required, and to allocate land to develop them by joint management between the people and the Forest Department. Just as a habitat evaluation and wildlife census is essential to study the biological aspects of each PA, a study of the effects of biotic pressures is essential to provide data on the impact of the PA on these communities through a Participatory Rural Appraisal (P.R.A.).

The level of conflict is an important issue and a variety of site and issue specific measures, to mitigate conflict, must be identified if the PAs are to be given long-term prospects of survival.

Though based on some subjective and other quantified parameters, the evaluation scale designed in this paper provides a set of rational guidelines for assessing PAs. These can be refined and the number of parameters increased and quantified by detailed field studies to improve accuracy. There is however, a great need to standardize methods that can be widely used under different situations. This would permit a more objective analysis of conservation assets at the global and national levels. As stated by Stewart and Sullivan (1994), "an important area for continued research and dialogue is the development of a global system for landscape classification by habitat type which is needed to underpin priority site selection..." According to their paper, it is important in future for organizations such as the IUCN to identify, "valid methods of selecting priority sites using objective, scientifically based criteria."

An important need is to establish 'special objective PAs', to act as model management areas. For example to (a) manage 'Multiple Use Areas' as suggested for the proposed Ujjaini Bird Sanctuary where aquatic avifauna and fishing can co-exist (Bharucha and Gogate 1990); (b) to protect an endangered species, such as the endemic Mahseer fish at Lonavala, the Giant Squirrel in the Western Ghats and for the several endemic plants of the Sahyadris in the Deorais in a "cluster PA" (Bharucha 1991); (c) increase public awareness for conservation, for instance at the Mula-Mutha Bird Sanctuary - Pune; and the Sanjay Gandhi National Park, Pench and other PAs which have a large number of visitors and d) to identify corridors for existing PAs in the Western Ghats. The last is of great importance to species whose gap crossing ability is relatively low (Dale *et al* 1994).

Several areas of conservation value have been recently identified as potential sites to be included in the PA network. Still others require careful selection to create a balanced bio-geographical representation in the IPAS. New areas must be selected to protect areas having high levels of biodiversity, or which have relict ecosystems, or those that harbor endangered species outside the present IPAS. (Bharucha 1991, Rodgers and Panwar 1958; Conservation of Mangroves in India 1990; Conservation of Wetlands in India 1989).

Some PAs need to be given a higher conservation status by upgrading them from Wildlife Sanctuaries to National Parks. Others require an addition to their existing size, or a redemarcation of their boundaries (Annexure IV).

A rational IPAS established and supported by Government and people is an essential requirement to preserve the valuable biological resources of the State of Maharashtra. This is as important as the development of agriculture and industry. Notifying land as Protected Areas creates an asset that has immense long-term economic implications which have not been fully appreciated. An IPAS for Maharashtra is a basic requirement of good land-use planning for the future well-being of the State.

Annexure III

IMPLEMENTATION OF AN IPAS

1.1 Selection of PAs based on biogeographic and conservation values.

1.2 Management planning for component PAs based on site specific objectives.

1.3 Notification of new PAs on a biogeographical basis.

1.4 Strengthening of the Wildlife Wing of the Forest Department.

2.1 Integrating ecodevelopment activities for dependent settlements into PA management plans.

2.2 Mitigating people-wildlife conflict.

3.1 Completing legal processes of notification of PAs.

4.1 Upgrade research and training facilities for wildlife preservation and PA management.

5.1 Reorganizing wildlife tourism.

6.1 Increasing public support through a comprehensive conservation awareness programme using target specific mass media programmes.

6.2 Integrating conservation biology and resource management into school and college curricula and establishing Nature Awareness Areas at Taluka level.

7.1 Improving conservation oriented inputs in Multiple Use Areas outside the IPAS.

8.1 Providing financial support and expertise for *ex-situ* conservation and re-introduction of threatened or vulnerable plant and animal species.

9.1 Integrating the IPAS into an overall land-use strategy for the state.

Annexure IV

RECOMMENDED CHANGES TO RATIONALIZE AN IPAS IN MAHARASHTRA

I. New PAs*: To balance representation on biogeographical basis.

a) Forests: Rev. Fr. Santapau - Lonavala; Western Ghat Deorais - cluster PA; Mahabaleshwar; Bhamragarh; Darekasa; Sironcha potential Jerdon's courser habitat); Tipagarh - Ghadchiroli.

b) Grass-Scrubland: Mahadeo range - Satara (wolf sanctuary); Sonurli - Chandrapur (wolf sanctuary); Lonar crater; Nandgaon; Gnanganga; Akola; Kolhapur; Wadali; Lalling- Dhulia; Ramlingghat - Osmanabad.

c) Wetlands: Ujjaini (Bhigwan); Mula-Mutha - Pune; Itiadoh - Rajoli; Tipeshwar; Mayeni.

d) Coastal: Roha; Vikhroli; Dasgaon; Akhra; Turtle beaches; Arabian Sea Islands.

* Some of these would require NP status.

II. Proposed changes in size or redemarcation of present PA boundaries:

a) Increase size: Andhari and Tadoba; Navegaon; Nagzira; S. Gandhi, Phansad and Karnala.

b) Reduce size: Great Indian Bustard Sanctuary.

c) Redefine boundaries: This is necessary for a large number of PAs to include vital corridors or adjacent wilderness. Or to exclude valueless degraded areas. This may or may not involve a change in size.

III Proposed changes in status of present PAs:

a) Upgrade (W-L Sanctuary to NP): Melghat, Koyna, Radhanagari.

b) Downgrade : None at present.

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